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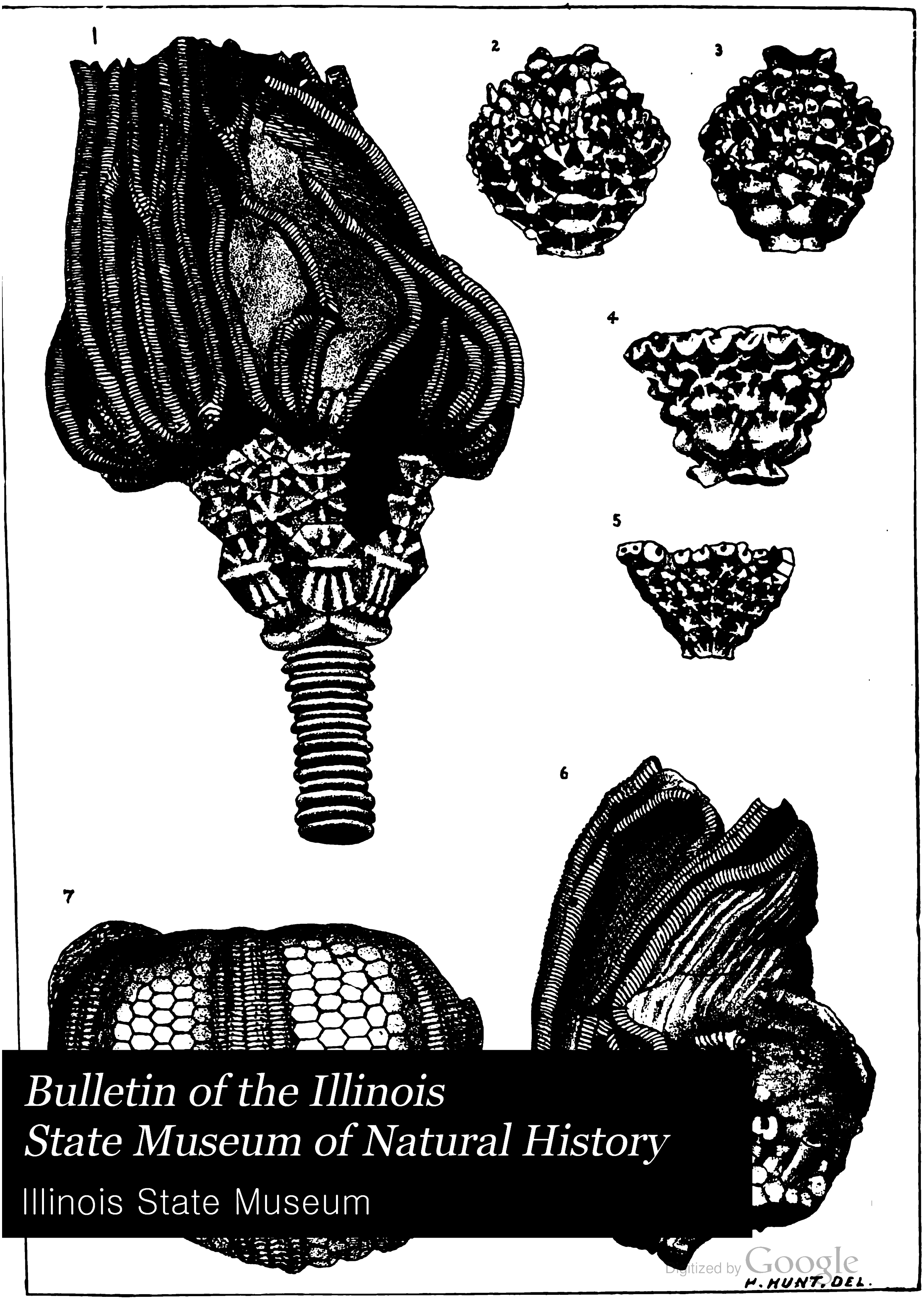

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BULLETIN NO. 3

8176.

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY.

DESCRIPTION OF SOME NEW SPECIES OF INVERTEBRATES FROM THE PALAEOZOIC ROCKS OF ILLINOIS AND ADJACENT STATES

BY S. A. MILLER AND WM. F. E. GURLEY.

8 plates

SPRINGFIELD, ILLINOIS,
December 1, 1893.

SPRINGFIELD, ILL.
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SUBKINGDOM ECHINODERMATA.

CLASS ECHINIDA.

ORDER PERISCHOECHINIDA.

FAMILY PALAECHINIDÆ.

MELONITES INDIANENSIS, n. sp.

Plate I, Fig. 1, apical view.

Our specimen is injured, in a few places, though it is not easy to trace the outlines of the plates in the ambulacral depressions, and hence they are not distinguished in the illustration. The central basal part is destroyed and the oral plates are gone.

The form is strikingly melon-like, notwithstanding the depressions at the poles. The vertical height is two and fifteen-hundredths inches, and the transverse diameter is two and sixty-five-hundredths inches. The surface of the plates is covered with tubercles that formed the bases of spines. And some of the spines may be seen scattered over parts of the ambulacral depressions. The spines are minute, elongate, tapering, cylindrical in section, swollen a little at the basal extremity, and about one-tenth of an inch in length.

The interambulacral areas are lance-elliptical in outline, abruptly elevated from the ambulacral depressions, sharply rounded at the apical pole, more gently rounded toward the middle, while the middle part is only slightly convex. There are six ranges of plates at the middle part, a little higher only five, a little higher only four, and then there are only three, which grow smaller and terminate each interambulacral area by abutting a genital plate. There are from twenty to thirty tubercles on the larger plates.

Ambulacral areas as wide in the middle part, and wider toward the poles than the interambulacral areas, and separated in each ambulacral field the entire length by a sharply defined ridge elevated as high as the interambulacral areas. The plates are smaller and more irregular in the ambulacral depressions than elsewhere. The ambulacral pores are circular, two in each plate, and form four irregular ranges of pairs in each depression. When the two depressions, in each ambulacral area, unite near the ocular plate there are five or six rows of pores. The small plates are pierced with the ambulacral pores until they actually abut upon the little ocular plates.

Three pores are clearly distinguishable, in some of the genital plates, with an ordinary magnifier, and there are some evidences of other pores that have been closed or filled up. There are no pores in the ocular plates. The plates abutting the oral opening are angular and preserve the articulating edges of the oral plates.

Found in the St. Louis Group, at Greenville, Harrison county, Indiana, and now in the collection of Wm. F. E. Gurley.

OLIGOPORUS BLAIRI, n. sp.

Plate I, Fig. 2, the upper part of a specimen, somewhat crushed, and preserving none of the apical plates; Fig. 6, a smaller specimen, crushed so as to show only part of the ambulacral pores; Plate II, Fig. 7, the middle part of a much larger and flattened specimen.

The three specimens enable us to ascertain most of the external characters of this species, excepting the apical and basal plates, none of which are preserved. If they all belong to the same species, as we think, then they show great differences in the size of the plates and in the number longitudinally, without increase in the number of ranges, in either the ambulacral or interambulacral areas. In other words, if the three specimens belong to the same species, the plates increase, in size, with the growth, by accretion laterally, without intercalation of plates, but increase longitudinally by the intercalation of plates, and very little by accretion. We would not be understood as affirming positively that this is the law governing the growth of this species, for if so, it would, probably, be the law in the growth of all species in this genus, and also in the family. We have not enough evidence in the three specimens before us, injured as they are, to positively affirm that they belong to the same species, but we think the weight of the evidence is in that direction, and hence we suggest the probability of the method of growth, the correctness of which will be determined by the examination of other specimens.

The interambulacral areas are lance-elliptical, in outline, moderately and evenly convex from one ambulacral depression to another. There are six ranges of plates at the middle part. The plates where well preserved, are covered with tubercles that appear to have been the bases of spines, though none of the spines are preserved on our specimens.

The ambulacral areas are about half as wide, in the middle part, as the interambulacral areas, and of almost uniform width throughout their length, tapering very slowly as they approach the summit and ocular plates. They are separated in each ambulacral field, by a sharply defined ridge elevated higher than the interambulacral areas. The plates are short and small in the ambulacral depressions and each one is pierced with a pair of circular pores. There are two ranges of these ambulacral pores in each depression throughout the length without the addition or intercalation of any plates or pores.

This species is distinguished from *O. danæ*, by the fact, that there are only six instead of eight ranges of plates in each interambulacral area.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of both authors.

OLIGOPORUS BELLULUS, n. sp.

Plate I, Fig. 3, part of the upper half of a crushed specimen.

The surface of the plates, in our specimen, is coverd with tubercles, that formed the bases of spines, and some of the spines are scattered over parts of the ambulacral depressions. The spines are minute, elongated, tapering, cylindrical in section, swollen a little at the basal extremity, and about one-tenth of an inch in length. Oral, genital and ocular plates unknown. The form of our fragment indicates a length greater than the diameter, but as this is different from the form of all other species, it cannot be asserted any stronger than the appearance shown by the illustration.

The interambulacral areas are elongate-lance-elliptical, in outline, and moderately convex transversely. There are only four ranges of plates at the middle part, and they extend almost to the summit, where one terminates, and the other three continue to the genital plates.

The ambulacral areas are nearly as wide in the middle part, as the interambulacral areas, and they are of almost uniform width throughout their length, slowly tapering as they approach the summit and ocular plates. They are separated in each ambulacral field by a sharply defined ridge, elevated higher than the interambulacral areas. The plates are short and small in the ambulacral depressions and each one is pierced with a pair of circular pores. There are two ranges of these ambulacral pores in each depression throughout the length, without the addition or intercalation of any plates or pores.

This species is distinguished from all others by its general form and by having only four ranges of plates in the interambulacral areas.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of Wm. F. E. Gurley.

OLIGOPORUS SULCATUS, n. sp.

Plate I., Fig. 4, basal view; Fig. 5, apical view.

Our specimen with the exception of the loss of a few plates is quite complete. It is silicified and not compressed in any direction, most of the sutures are more or less destroyed, but the outlines of some of the plates are preserved, and where the plates are broken wholly away, the cast shows the bases of the plates distinctly. The lower half has more of the plates broken away and shows the pores of the ambulacral areas better than the other half. The mouth, ocular, genital and anal plates are not preserved, with the exception of one ocular and two genital plates, that may be distinguished.

The form is strongly melon-like. The vertical height is two and two-tenths inches, and the transverse diameter two and six-tenths inches. The silicification destroyed the tubercles and all evidence of spines.

The interambulacral areas are somewhat lance-elliptical, in outline, abruptly elevated from the ambulacral depressions, sharply rounded at the apical pole, and broadly rounded near the basal extremity, and flattened on the outer face, throughout the whole length. There are seven ranges of plates at the middle part, including the two that dip down into the ambulacral depressions on the sides, or five occupy the flattened surface on top. One of the middle ranges is short, another soon gives way to the narrowing of the area, and while five reach near the basal extremity, only three extend toward the apical end to unite with a genital plate.

Ambulacral areas only half as wide, in the middle part, as the interambulacral areas, and of almost uniform width throughout their entire length, tapering only slightly as they approach the summit and ocular plates. They are separated in each ambulacral field by a sharply defined ridge, elevated as high or rather above the interambulacral areas. The plates are very small in the ambulacral depressions and each one is pierced with a pair of circular pores. There are two ranges of these ambulacral pores in each depression throughout the entire length, and, in the middle part, there seem to be additional pores, but their extent is not exactly determined.

This species will be readily distinguished from *Melonites indianensis*, by the flattened interambulacral areas, and from it and all other described species, in that genus, by the narrow ambulacral areas, with almost uniform width, and by the two ranges of pores in each depression. We do not know the plates that cover the summit or the base of either *Melonites* or *Oligoporus*. Notwithstanding, Prof. Hambach (Trans. St. Louis Acad. Sci. Vol. IV. p. 549) has examined over 500 specimens of *Melonites multiporus*, and described new species of *Melonites* and *Oligoporus*, these important plates remain unknown. It is wholly unnecessary to compare this species with any other in the genus, because it is not only from a different group of rocks, but it is widely different in form from all of them.

Found in the St. Louis Group, in Hardin county, Kentucky, and now in the private collection of Wm. F. E. Gurley.

CLASS CRINOIDEA.

ORDER PALAEOCRINOIDEA.

FAMILY ACTINOCRINIDÆ.

ACTINOCRINUS GIBSONI, n. sp.

Plate 2, fig. 1, dorsal, or opposite view from the azygous side.

Species very robust: column, calyx, and arms large. Our specimen is compressed, but evidently the calyx is quite as long as wide, deeply sculptured, plates thick, and interradial areas rather small. Proboscis unknown, but another specimen, probably belonging to this species, has a moderately long proboscis curved to one side toward the top, and is covered with tumid plates like an *Eretmocrinus.* Column composed of thicker and thinner plates, the former projecting beyond the latter.

Basals one half wider than high, very thick, contracted in the middle so as to leave an expanded rim projecting much beyond the column and widely gaping at the sutures in the rim, the excavation being almost triangular and extending nearly to the radial plates; upper part of the plates having three short, longitudinal ridges that fade away before reaching half the length of the plates.

First primary radials very large. nearly half as long as the calyx, one-third longer than wide, three hexagonal, two heptagonal; the surface is marked with a strong transverse tubercle in the middle part, from which the heptagonal plates have two radiating ridges extending to each of the adjoining basals and one toward each of the other adjoining plates; and the hexagonal plates have three ridges extending to the single abutting basal and one toward each of the other adjoining plates; each plate also bears a small, round tubercle above the transverse one. Second primary radials less than half the size of the first; hexagonal superior sloping sides shorter than the inferior; surface ornamented with a high pointed tubercle and a rounded radiating ridge directed toward each adjoining plate. Third primary radials smaller than the second; heptagonal, ornamented in the same way that the second are, and bearing upon each upper sloping side a single secondary radial. The secondary radials are quite small and thin, and each one bears three or more short tertiary radials before the arms become free. Most of the arms bifurcate almost immediately after becoming free, and again at irregular distances from the calyx. The ray on the left of the specimen illustrated preserves nine arms near the calyx, and probably the lower one bifurcated at the place at which it is broken off, and two of the arms are preserved above another division. The ray on the right of the illustration, though not so well preserved, appears to have had the same number of arms. The central ray, however, appears to have had only six arms, near the calyx, and only one of these is preserved far enough to show a second bifurcation. The probability is that a complete specimen would have from forty-six to fifty arms, near the calyx, and a number of bifurcations above. The arms are exceedingly long and of uniform size, each branch being about as large as the arm below the bifurcation. They are composed of a double series of very short interlocking plates bearing dense pinnules.

First regular interradial hexagonal smaller than a second primary radial, followed by two smaller plates in the second series, and three smaller ones in the third, that unite with the plates of the vault. Surface of the interradials ornamented the same as the second and third primary radials. Azygous plates unknown.

This species is remarkable in the number and structure of the arms, and the surface ornamentation of the calyx will also serve to distinguish it. Possibly this species belongs to *Eretmocrinus*, though the arms are those of *Actinocrinus*.

Named in honor of William Gibson, of Belpre, Kansas, to whom science is indebted for the discovery of many interesting fossils.

Found in the Keokuk Group, on Indian creek, near Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

ACTINOCRINUS AUGUSTATUS, n. sp.

Plate XII, Figs. 8 ana 8a, Vol. VIII, Geo. Sur. Ill., and described on page 97 of the same volume, as Actinocrinus lobatus, Hall.

Body large. Calyx somewhat obpyramidal, longer than wide; radial ridges moderately protuberant; interradial areas small, somewhat flattened and slightly depressed; plates thin; surface ornamented with low radial ridges, which commence on the first radial and extend to the tertiary radials, and with short radiating ridges from the center of each plate to each adjoining plate, while the interradials bear a central node with a low radiating ridge to each adjoining plate. Dome conical and slowly diminishing into a large ventral tube composed of tumid and strongly protuberant plates.

Basals three, pentagonal, about as large as the first radials, and forming a cup, half as high as wide, slightly constricted in the middle, so as to form a rounded rim, on the lower half, that projects a little beyond a rather large column; surface smooth, not sculptured.

First primary radials large, length and breadth subequal, hexagonal and heptagonal. Second primary radials about half as large as the first, hexagonal and having the superior sloping sides shorter than the inferior sloping sides, (Fig. 8 is not exactly correct, in this respect, the artist having followed an ink line instead of the suture). Third primary radials smaller than the second, heptagonal and bearing upon each upper sloping side a single secondary radial. Each secondary radial supports on each upper sloping side three or four tertiary radials, one of which in each series is axillary on the third plate, from which two arms arise, which gives six arms to each radial series, so far as they are preserved in the two specimens illustrated, by figs. 8 and 8a, or thirty arms in the species. The arms are composed of a double series of interlocking plates and they frequently bifurcate. One tertiary series illustrated in fig. 8a shows eight arms within an inch of the calyx, and if the other arms bifurcate in like manner, there are eighty arms within an inch of the calyx, and, judging from appearances, there are numerous bifurcations above those shown in the specimen.

First interradial hexagonal, smaller than a second primary radial, followed by two smaller plates, in the second series, three smaller ones in the third series, and three smaller ones in the fourth series, that unite with the plates of the vault.

The first azygous plate is smaller than a first primary radial, it is followed by two plates in the second series, three in the third, and four in the fourth, above which the plates are not determined.

This species is remarkable for the great height of the vault and large proboscis, in proportion to the size of the calyx. It is also remarkable for the number of arms and their bifurcations.

Found in the Keokuk Group, in Greene county, Illinois, and now in the Illinois State Museum and numbered 2594.

Actinocrinus lobatus was described by Hall, in 1859, in his Supplement to the Geology of Iowa, page 51, without an illustration. It has never been illustrated, and we are not sure that we have ever seen a specimen of it. The vault is described as "irregularly convex above," while this species is remarkable for its conical vault and extremely large proboscis. The calyx is described as "distinctly divided into lobes by the depression of the interbrachial and anal spaces," which is not the case in this species. That species could not "have had more than twenty-five arms," while this species has not less than thirty. That species has four regular interradials in the fourth range, while this species has only three. The surface of the plates, in that species is traversed by "sharp ridges," in this species the ridges are low and broadly rounded. The nodes on the radial series, in that species are transverse, in this species they are longitudinal. The ridges "from the first radials to the basal plates are four," in that species, in this species there is only one; those from one first radial plate to the other in that species are two, in this species only one; those from the first radial to the second, in that species are two, in this species there is only one. Hall compared that species, with *Actinocrinus lowei*, from which he distinguished it in a few minor particulars, but this species is so far removed from *A. lowei* in every important particular, that no one would think of comparing the two. There are no two species of *Actinocrinus* farther removed from *A. lowei* and *A. lobatus*, than the one here under consideration, and we are quite at a loss to understand why the late distinguished palæontologist, Prof. Worthen, should have thought of identifying this species with either one of them. The mistake may have been overlooked because he died before the publication of the work.

ACTINOCRINUS ERRATICUS, n. sp.

Plate II, Fig. 2, view opposite the azygous side; Fig. 3, azygous view.

Body medium size. Calyx very little larger than the dome, somewhat obpyramidal, the radial series being slightly more prominent than the interradials, diameter one-half greater than the height; plates thick, tumid and sculptured. Dome elevated at the arm openings, subpyramidal, being most prominent in the direction of the radical series and covered with tumid and spinous plates. Proboscis central.

Basals short, more than three times as wide as high, projecting beyond the column, in the form of a small rim, separated at the sutures, so as to have a somewhat hexagonal outline; sculptured longitudinally, so as to show a short ridge directed toward each adjoining plate.

First primary radials the larger plates of the body, nearly as long as wide, very tumid transversely and having a short ridge directed toward each adjoining plate. Second primary radials a little smaller than the first, wider than long, transversely tumid and having a short ridge directed toward each adjoining plate. Third primary radials about as large as the second, much wider than high, transversely tumid, having radial ridges, and bearing upon each upper sloping side a single secondary radial, which, in turn, supports upon each upper sloping side two tertiary radials. There are twenty arm openings to the vault.

First regular interradials of the same size as the second primary radials; each one bears a strong central tubercle with a radiating ridge directed toward each adjoining plate; it is followed by two smaller plates, each of which bears a central tubercle; these are followed by two still smaller plates, each bearing a central tubercle, and these are followed by a single non-tuberculated plate within the interradial area proper, making six plates in the area. The last one, however, is followed by a long narrow plate, that separates the tertiary radials and unites with the plates of the vault.

There are eight plates in the azygous area. The first one is in line with the first radials, and of the same size; it is equally as tumid and sculptured in the same manner; it is followed by two plates of the same size as the second primary radials or first regular interradials, and each one bears a strong central tubercle, with a radiating ridge directed toward each adjoining plate. These are followed by three smaller plates, each of which bears a central tubercle with radiating ridges toward the plates below. These are followed by two small non-tuberculated plates, which terminate the azygous area proper, though two or three small, elongated plates separate the tertiary radials and connect with the plates of the vault.

This species has the general aspect of *A. proboscidialis.* The radial series, however, are more prominent and the interradial and azygous areas larger, and each contains twice as many plates. It is quite as far removed from *A. dalyanus*, in the structure of the interradial areas, and in the surface ornamentation.

It was found in the Drift, at Danville, Illinois, but no doubt belongs to rocks of the age of the Burlington Group, immediately north of Danville, and which are covered by the Drift. The type is in the collection of Wm. F. E. Gurley.

ACTINOCRINUS ARROSUS, n. sp.

Plate II, Fig. 4, side view of a calyx, somewhat flattened.

Specimen medium size. Calyx with a flanging base abruptly truncated below, and rapidly expanding tertiary radials. Length and breadth nearly equal; plates tumid and sculptured. Vault, proboscis and arms unknown.

Basals short, about half as high as wide, sharply flanged below so as to make a broad, flat base with deep notches at the basal sutures. The plates are longitudinally furrowed, so as to further interrupt the flange and give it additional notches.

First primary radials the larger plates of the body, as long as wide, very tumid and protuberant, and having a small ridge directed toward each adjoining plate. Second primary radials about half as large as the first, nearly as long as wide, though unequal in size and shape; two are quadrangular, two pentagonal and one hexagonal; they are tumid and have a small ridge directed toward each adjoining plate. Third primary radials of unequal size and shape, some larger than the second radials and others much smaller; they are pentagonal, hexagonal and heptagonal; they are tumid, have radial ridges, and bear upon each upper sloping side a single secondary radial, which in turn supports upon each upper sloping side two tertiary radials. There are twenty arm openings to the vault.

First regular interradials larger than the second primary radials, very tumid and bearing a small radiating ridge directed toward each adjoining plate; it is followed by two much smaller plates, each of which bears a central tubercle, with a radiating ridge directed toward each adjoining plate; these are followed by a single plate that separates the secondary radials. The tertiary radials come together, and hence there are only four plates in any regular interradial area.

There are only four plates in the azygous area. The first one is in line with the first radials, fully as large and rather longer, quite as tumid and sculptured in the same manner. It is followed by two plates that are nearly as long as the second and third primary radials together, each one bears a very strong central tubercle with a radiating ridge directed toward each adjoining plate. These are followed by a single plate that bears a central tubercle and separates the secondary radials. The tertiary radials come together.

One side of our specimen is longer than the other and the inequalities in the plates might be ascribed to that and the whole credited to an abnormal specimen belonging to some other species. The fact that the tertiary radials unite at the base of the arms would lead one to think that it is a *Batocrinus*, but

that show slight sculpturing. Vault and proboscis unknown.

Basals short, twice as wide as high, standing upright and longitudinally marked with three or four delicate stripes.

First primary radials the larger plates of the body, as long as wide, slightly convex, and bearing a delicate ridge directed toward each adjoining plate. Second primary radials, less than half as large as the first, hexagonal, and ornamented with delicate ridges. Third primary radials about as large as the second, pentagonal and hexagonal, ornamented with delicate radial ridges and bearing upon each upper sloping side a single secondary radial, which, in turn, supports upon each upper sloping side two tertiary radials. There are twenty arm openings to the vault.

Regular interradials six. First one smaller than a second primary radial, it is followed by two smaller plates and these by two still smaller ones and these by a single plate, above which a long narrow plate unites with the plates of the vault.

There are ten plates in the azygous area. The first one is in line with the first primary radials and of the same size and sculptured in the same manner; it is followed by two plates of about the size of the second radials, and these are followed by four smaller plates, and these by two plates and these by a single plate that unites with an elongated plate that connects with the plates of the vault.

The arms are very long and comparatively coarse and composed of a double series of interlocking plates. Pinnules dense.

Distinguished by the delicate sculpturing and number of interradial and azygous plates.

Found in the Burlington Group, at Burlington, Iowa, and

CORRIGENDA.

Page 17. 7th line from bottom, ERETMOCRINUS LYONANUS should read ERETMOCRINUS CASSEDAYANUS.

Page 18. 15th and 16th lines from bottom should read S. A. Casseday instead of S. S Lyon.

Plate III. Fig. 1 should read ERETMOCRINUS CASSEDAYANUS instead of ERETMOCRINUS LYONANUS.

radials are longer than wide and the larger plates of the calyx. The second primary radials are small, leaving comparatively wide interradial areas. The secondary and tertiary radials are short.

Some of the arms are well preserved and others torn into pieces. There are, as it appears, twenty very long, compound, ponderous arms, remarkable for their expansion, in the upper part. There are also twenty arm openings to the calyx. There are three single, short plates in the commencement of each arm; these are followed by a double series of interlocking plates that are deeper than wide, making the arm in the lower part deeper than wide. The arms gradually widen externally until they are about four times as wide as deep. In the lower part of the arms the arm furrows are shallow and the arms are twice as deep as wide, they do not increase, in depth, in the upward extension, even where they are four times as wide as deep.

This species is distinguished from all others by the thin, smooth, slightly convex plates of the calyx and by the remarkably heavy arms.

Found in the upper layers of the Burlington Group, near Burlington, Iowa, and now in the State Museum, at Springfield, Illinois. The specific name is in honor of one of the founders of the genus, the late distinguished palæontologist, Sidney S. Lyon, of Jeffersonville, Indiana.

BATOCRINUS LYONANUS, n. sp.

Plate III, Fig. 4, view opposite the azygous area; Fig. 5, basal view.

Body above medium size. Calyx basin shaped, and spreading horizontally from the secondary radials; two and a half times as wide as high; plates thick, angular; sutures beveled; arm openings directed horizontally. Vault conical, nearly as large as the calyx, covered with polygonal, tumid plates and having a large subcentral proboscis.

Basals short, more than three times as wide as high and excavated below, so the concavity has a depth greater than the external height of the plates. First primary radials one and a half times as wide as high. Second primary radials quadrangular, half as large as the first, and only a little wider than high. Third primary radials a little larger than the second and bearing upon the upper sloping sides the secondary radials. There are two secondary radials in each of three radial series, the second one being about twice as large as the first and bearing upon each upper sloping side three tertiary radials, thus giving to each of these three radial series four arms. The radial series on the left of the azygous area has one-half of it constructed in the same manner; the other half, being the one most distant from the area, possesses no tertiary radials, but has four secondary radials, and, therefore, in this series, there are only three arms. The radial series opposite the azygous area has no tertiary radials, but it has four secondary radials on each of the upper sloping sides of the third primary radials, and, therefore, there are only two arms in this series. The species has only seventeen arm openings to the calyx.

In each regular interradial area there are three plates, the first of which are the larger plates of the calyx, and each one has eight sides. It rests between the upper sloping sides of the first primary radials and the second and third primary radials abut it on each side, and it supports, on top, the other two interradials. The upper interradials are never of equal size; they are situated between the first secondary radials and below the tertiary radials.

The azygous area is subovate in form, and contains six plates. The first one is in line with the first primary radials and of the same size. It is followed by three plates, that differ but little in size, and these are followed by two plates, in the third range, that are situated between the second secondary and first tertiary plates, and thus extend a little higher than the plates do, in the regular interradial areas.

In *Batocrinus facetus* the three armed series is on the right of the azygous side, in this it is on the left. In that species, there are four regular interradials and eleven azygous plates, in this species, there are three regular interradials and six azygous plates. It is a marked species that cannot be mistaken for any other one.

Found in the St. Louis Group, in Hardin county, Kentucky, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of the late Sidney S. Lyon, who did so much valuable work in this family of crinoids.

BATOCRINUS ALTIUSCULUS, n. sp.

Plate V, Fig. 1, side view, azygous area on the right; Fig. 2, azygous view; Fig. 3, summit view of the same specimen, part of the top being broken away.

Body large, above the medium size. Calyx long, somewhat bell-shaped, very slowly and somewhat evenly expanded from the base to the second radials and then spreading horizontally; nearly as high as wide; arm openings directed horizontally; plates convex; sutures depressed; surface smooth or finely granular.

Basals form a subcylindrical cup nearly as high as wide, truncated and round at the base, with a round facet for the attachment of the column deeply impressed, and about two-thirds of the diameter of the base. The columnar canal is large and pentagonal. A little above the truncated base there is a high transverse ridge across each plate, that is broken at the sutures, giving to this band when viewed from below a subhexagonal outline. Above the band the basals slowly expand. First radials longer than wide, nearly as large as the basals, lower third most convex, three hexagonal, two heptagonal, and rising almost vertically from the basals. If the usual quadrangular second radials exist, in this species, they are anchylosed with the third radials, in our specimen, so as to form single pentagonal plates about one-third as large as the first radials, axillary, and bearing upon each upper sloping side two secondary radials, the second being larger than the first. The second secondary radials are axillary and bear two or three tertiary radials upon each superior sloping side, which gives to the species twenty arm openings to the vault.

Regular interradials, two in each area, one above the other, the second one less than half as large as the first, and situated between the secondary radials. There are seven plates in the azygous area. The first one is in line with the first primary radials and of about the same size, being slightly narrower and a little longer. It is followed by a range of three plates, each of which is about one-third as large as the first. There are three small plates in the third range, below the tertiary radials, in the adjoining radial series.

Vault elevated over the arm openings, convex and having, comparatively, a small subcentral proboscis. It is composed of very irregular, polygonal, tumid plates, without any apparent order as to size or arrangement. The proboscis is broken off so its length is not ascertained.

This species bears most resemblance to *B. christyi*, from which it is distinguished by the longer form of the calyx, longer basals, longer and more convex first radials, shorter second and third radials (if this species possesses the second quadrangular plate) more elevated vault over the arm openings, less convex beyond, smaller proboscis, and more tumid plates. Indeed very slight observation will distinguish the two species.

Found by the laborious naturalist and indefatigable collector, R. A. Blair, of Sedalia, Missouri, in the upper part of the Burlington Group near Blackwater Station, a few miles west of Booneville, in that State, and with his usual generosity presented to one of the authors—S. A. Miller.

BATOCRINUS ASPRATILIS, n. sp.

Plate V, Fig. 4, azygous view; Fig. 5, lateral view; Fig. 6, summit view.

Body of our specimen unsymmetrical, one side larger than the other, which may or may not be abnormal. The species is of medium size and the vault is nearly as large as the calyx. Calyx broadly truncated at the base and very rapidly expanding in the upper part; about half as wide as high; arm openings directed horizontally; plates highly convex; sutures distinct; surface granular.

Basals thick and form a low subhexagonal cup, about three times as wide as high, with a round, deep columnar depression, having a concave, radiately furrowed bottom, for the attachment of the column. The base is about two and a half times as wide as the diameter of the column. The basal plates stand nearly upright; they are flattened, in the central part, and beveled toward the sutures, which makes the cup hexagonal. First radials smaller than the basals, of unequal size, and about twice as wide as high, three hexagonal, two heptagonal, and directed at an angle of about thirty degrees from the basals. Each one is transversely, highly convex, the elevation being obtusely angular.

Second radials quadrangular and very short, being from three to six times as wide as long. Third radials pentagonal, twice as wide as high, convex in the central part, axillary, and bearing upon each upper sloping side two secondary radials. The second secondary radial is larger and much wider than the first, axillary, and bears upon each upper sloping side two or three tertiary radials. On one side of our specimen, there are only two tertiary radials, in each series, and on the other side there are three, in each series, which makes one side of the calyx larger than the other. The proximate ray on each side of the azygous area has an axillary tertiary radial so that each of these rays has five arm openings to the vault. This gives to the species twenty-two arm openings to the vault.

There is only one regular interradial in each area, which is a large, tumid, conspicuous plate. There are five azygous plates. The first one is in line with the first radials and of nearly the same size and quite as tumid. There are three plates in the second range, the middle one being a short quadrangular plate, twice as wide as long, the lateral ones being comparatively large, tumid plates. There is only one plate in the third range, which is nearly as large as the first and very tumid. The azygous area is slightly wider than high, or nearly square in outline, with a flat, wide, quadrangular plate, in the center, surrounded by four tumid plates occupying the angles of the square.

Vault somewhat elevated over the arm openings, convex toward the central part and having a subcentral proboscis. It is composed of irregular, polygonal, tumid plates arranged, in some order, as five quite tumid plates, half way from the margin to the center, are in line with the primary radial series. The proboscis being broken off, and the length is unknown.

This species is so different from all others having twenty-two arms, that it is unnecessary to make a comparison with any of them for the purpose of distinguishing it. The single, regular interradial and the arrangement of the five azygous plates, with their peculiar shape and convexity will alone distinguish it from all other described species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS SCYPHUS, n. sp.

Plate V, Fig. 7, azygous view; Fig. 8, lateral view; Fig. 9, summit view.

Body medium size. Calyx bowl shaped, rounded at the base and very gradually expanding to the summit; about one-third wider than high; arm openings within the upper margin of the summit and directed upward; plates thin, plain, not convex; sutures not very distinct; surface smooth or granular.

Basals very low, curving into the columnar cavity and upward about as high as the depth of the cavity. First radials the larger plates of the body, wider than high, gradually expanding, three hexagonal, two heptagonal. Second radials quadrangular, about twice as wide as high. Third radials short, twice as wide as high, pentagonal, axillary, and bearing upon each upper sloping side two secondary radials. The second secondary radials are axillary, larger and wider than the first, and bear upon each upper sloping side, in four of the radial series, two tertiary radials; but in the ray opposite the azygous area, there is only one tertiary radial, in each series, one of which is smaller than the other. There are, therefore, twenty arm openings to the vault, but two of the openings opposite the azygous area are smaller than the others, and, hence, it would appear, that the arms are not of equal size; probably sixteen or eighteen are uniform, and the other two or four, as the case may be, are smaller or have fewer divisions. The arms themselves are wholly unknown, and the facet for their articulation is very obscure, in our specimen. They must have been very small and peculiarly constructed, with an extraordinary covering of the arm furrows, if we may be allowed to judge from the appearance of the orifices.

There is only one regular interradial plate in each area; it is nearly as large as the second and third radials together, or about half as large as a first radial. The azygous area is large and contains seven plates. The first one is in line with the first radials and rather longer; it is followed by three plates, the middle one of which is the larger and about the size of a regular interradial, and this range is followed by three rather large plates in the third range.

Vault depressed convex with a very small, short, subcentral proboscis. It is covered with irregular, polygonal, gently convex plates. The proboscis seems to be complete, except the covering, in our specimen, though it is possible small plates may have been broken from the top of it. It is evident it could not have been much higher.

This species agrees with *Batocrinus* in the plates of the calyx, but differs in all other respects from all described species. The arm openings and proboscis are peculiar and different from those in any other known species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS LAETUS, n. sp.

Plate V, Fig. 10, view opposite the azygous area; Fig. 11, azygous side view; Fig. 12, summit of same specimen.

Body medium size. Calyx obconoidal, truncated at the base, a little less than twice as wide as high, arm openings directed horizontally; plates thick, very highly convex, the convexity generally angular; sutures distinct; surface granular.

Basals moderately thick, and form a low, hexagonal cup, twice as wide as high, with a round deep columnar depression, having a concave, radially furrowed bottom, for the attachment of the column. The base is about twice as wide as the diameter of the column. The basal plates stand upright; they are flattened in the central part, and beveled toward the sutures, which makes the cup hexagonal. It will be observed, that the basals form a cup like that of *B. aspratilis*, except the plates are somewhat thinner. First radials longer than the basals, but somewhat shorter and of unequal size; they are, however, wider than long, three hexagonal and two heptagonal, with the superior sides slightly arcuate. Each one is transversely, highly convex, the elevation being obtusely angular. Second radials quadrangular, and about three times as wide as high. Third radials pentagonal, twice as wide as high, convex in the central part, axillary, and bearing upon each upper sloping side two secondary radials. The second secondary radials are only a little larger than the first, axillary, and bear upon each upper sloping side two tertiary radials. The proximate ray on each side of the azygous area has an axillary, tertiary radial, so that each of these rays has five arm openings to the vault. This gives to the species twenty-two arm openings to the vault.

There are two regular interradials in each area; the first one is very tumid, and about as large as the second and third primary radials together; the second one is about one-third as large as the first and quite convex. The azygous area is about as wide as high and contains six plates. The first one is in line with the first radials and fully as large and tumid. It is followed by three plates, in the second range, and two in the third, all of which are tumid and subequal in size.

Vault elevated, above the arm openings, and gently convex, toward the central part, and bearing a coarse, central proboscis. It is composed of irregular, polygonal, subspinous plates, arranged, so far as discovered, without order, in respect to the different radial areas. The proboscis commences, at the base, with a very large, transversely tumid plate, opposite the azygous side. The length of the proboscis is unknown.

This species is so different from all others bearing twenty-two arms, that no comparison is necessary to distinguish it.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS ÆQUABILIS, n. sp.

Plate V, Fig. 13, azygous view; Fig. 14, view opposite the azygous side; Fig. 15, summit of same specimen.

Calyx and vault somewhat equal in dimensions and together, somewhat wheel-shaped. Rather below the medium size. Calyx broadly truncated at the base, gently expanding to the top of the primary radials and then abruptly spreading horizontally to the free arms; more than twice as wide as high; arm openings directed horizontally; plates thick, highly convex on the lower part, but much less so above; sutures moderately distinct; surface granular.

Basals thick and form a low, hexagonal cup, about three times as wide as high, with a round, shallow, columnar depression, having a concave radiately furrowed bottom for the attachment of the column. The base is full twice as wide as the diameter of the column. The basal plates stand upright, they are flattened in the central part, and beveled toward the sutures, which makes the cup hexagonal. It will be noticed that the basals form a cup similar to that of *B. aspratilis*, except having a shallow, instead of a deep columnar cavity. First radials somewhat smaller than the basals, wider than long, three hexagonal, two heptagonal. Each one is transversely tumid. Second radials quadrangular and, at least, four times as wide as high, third radials pentagonal, very short, four times as wide as high and bearing upon each upper sloping side two secondary radials. The second secondary radials are much wider than the first, axillary, and bear upon each upper sloping side two tertiary radials. There are twenty arm openings to the vault.

There is only one regular interradial in each area, and it is a large tumid plate. The azygous area is fully as wide as long and contains four plates. The first one is in line with the first radials, rather larger and more tumid. There are three plates in the second range, the middle one being about as large as the other two together.

Vault moderately elevated over the arm openings and quite convex toward the central part. It bears a rather large, subcentral proboscis, the length of which is unknown. The vault is composed of irregular polygonal, subspinous plates, arranged, so far as discovered, without order, in respect to the radial areas. The proboscis commences at the base, opposite the azygous side, with a very large, transversely tumid angular plate.

This species is so different from all other trochiform species and from all others bearing twenty arms, that no comparison is necessary to distinguish it.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

STROTOCRINUS VENUSTUS, n. sp.

Plate VI, Fig. 1, side and basal view of the calyx.

Calyx medium size, urn shaped, below the tertiary radials, from which place it abruptly spreads horizontally. Surface deeply sculptured. Column round and perforated by a rather large subpentagonal canal.

Basals low, thick, deeply sculptured, notched at the suture lines, hexagonal in outline and extending below the columnar facet, where small nodes are made to terminate the sculptured ridges. First radials highert han wide, tw oheptagonal and two hexagonal and one pentagonal, central tubercle transverse and sending two ridges to the basal plates and one to each of the other adjacent plates. Second radials hexagonal, wider than high, a little smaller than the first radials, central tubercle only slightly elongated transversely, from which a ridge is directed to each adjoining plate. Third radials a little smaller than the second, wider than high, hexagonal, and bearing on the upper lateral sides a single secondary radial. Secondary radials smaller than the third primary radials and supporting on one of the upper sloping sides a single tertiary radial and on the other a series of three or more tertiary radials, before the arm becomes free; the exact number cannot be determined from our specimen. The single tertiary radials bear an axillary plate of the fourth order, which supports, on each upper sloping side, two or more plates before the arms becomes free. There are, therefore, at least twelve arms in each radial series or sixty arm openings to the vault in this species.

First regular interradial hexagonal, as large as the second primary radials, sculptured in the same way, and supporting two smaller but similar plates in the second range. The latter are followed by two smaller plates and these by one still smaller plate, which gives us six plates in each regular interradial area. There is one plate in each intersecondary radial area that rests on the third primary radial. There are nine plates in the azygous area. The first one is in line with the first radials, of the same size and sculptured in like manner. It is followed by three plates in the second range and these in turn by three smaller plates, above which there are two still smaller plates before the tertiary radials unite to cut off the azygous area from the plates of the vault.

The sculpturing on the plates in this species is similar to that on *Strotocrinus ectypus*, but otherwise it bears little resemblance to that species. It is so different in the form of the calyx and number of the interradials from *S. regalis* and kindred species that no comparison with any of them is necessary to distinguish it.

Found in the Burlington Group, at Burlington, Iowa, and now in the Illinois State Museum, at Springfield.

BLAIROCRINUS SPINOSULUS, n. sp.

Plate VII, Fig. 16, azygous view; Fig. 17, view opposite the azygous area; Fig. 18, summit view.

Calyx truncated at the base, obpyramidal, about twice as wide as high; plates sculptured; radial ridges rather sharp; interradial area flat; secondary radials and arm openings directed horizontally.

Basals three, forming a low, irregular, subhexagonal disc, nearly covered below by a round column, which is attached to the basals, by radiating denticulations. Columnar canal rather large, pentalobate. The little rim formed by the basals bears a node or short ridge directed toward each adjoining plate above. First primary radials the larger plates of the calyx, wider than high, three hexagonal, two heptagonal, convex in the central part, and sunken at the angles so as to leave a short ridge directed toward the center of each adjoining plate. Second primary radials quadrangular, about twice as wide as high, and similarly sculptured, though the radial ridge is much stronger than the transverse one. Third primary radials about the same size as the second, pentagonal, axillary, and bearing upon each upper sloping side two secondary radials, While there are only ten secondary radial series, there are two arm openings over each series, indicating that the arms, at once, bifurcated on becoming free.

Regular interradials three, one hexagonal plate resting between the upper sloping sides of the first primary radials and followed by two smaller elongated plates, that separate the secondary radials and connect with the plates of the vault. The first azygous plate is in line with the first primary radials, of about the same size, and sculptured in like manner. It is followed by two plates, in the second range, and three in the third range, which separate the secondary radials and connect wlth the plates of the vault.

The vault is strongly pentalobate, by reason of the horizontally projecting secondary radials extending beyond the upper part of the interradial areas. It is elevated over the arm openings, and gently convex toward the center. There is a spinous plate over each double arm opening, and between these spinous plates, in each radial series, there is a rather large plate, that separates them on a level with the top of the secondary radials, behind which there is a single large, spinous plate. The arrangement of these three spinous plates, over each radial series, is very much like it is in *B. trijugis*. The plates of the vault are rather large, and four of them bear very strong spines in addition to those above mentioned. The proboscis is subcentral, and probably very much like that in *B. trijugis*, though the top of it is broken off in our specimen.

The general form of this species will readily distinguish it from all others that have been described. It is most nearly related to *B. trijugis*, but in addition to the general form, it may be distinguished by having fewer plates in the interradial and azygous areas and by the plates of the vault.

Found by R. A. Blair, in the Chouteau Limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY CYATHOCRINIDÆ.

CYATHOCRINUS ANDERSONI, n. sp.

Plate III, Fig. 2, symmetrical side; Fig. 3, azygous side.

Calyx large, deep, cup-shaped, longer than wide, oblique, longer on the symmetrical than on the azygous side; plates very thick, tumid, and ornamented with wart-like protuberances; sutures very distinct. Column round and composed of plates near the calyx, which are highly inclined toward the azygous side.

Basal plates quite uniform, in size, and forming a round basin nearly three times as wide as high; each plate bears a strong, central tubercle and some of them have two tubercles. Subradials twice as large as the basals, four hexagonal and one heptagonal, very tumid and each one is ornamented, in the central area, with several large tubercles, irregularly disposed, and some of which are confluent. First radials larger than the subradials, tumid, deeply notched for the arm furrows and curving in at the superior lateral angles; facet for the reception of the second radials large and excavated downward two-thirds the length of the plates; plates ornamented, below the facet, with irregular tubercles. First azygous plate quadrangular, longer than wide, and resting upon the upper truncated side of the heptagonal subradial, and rising to the level of the bottom of the arm-furrows, in the first radials. The surface of it is also tuberculated.

This species is related to *C. farleyi*. Our specimen is much larger than the type of *C. farleyi*, which might account for differences in the surface ornamentation, if there were not other differences of specific importance. In that species, the basal plates are proportionally much smaller than they are in this, and form a flattened pentagonal disc, while in this, they form a basin, which increases the comparative length of the calyx. The superior lateral angles of the first radials, in that species, are truncated and stand upright, while in this species, they curve in over the margin of the vault and are not truncated. The facets for the second radials are proportionally much smaller, in that species, than they are in this, which indicates differences in the construction of the arms. As these differences in the construction of the calyx must rank as of specific importance, the surface ornamentation may also be used to distinguish the species.

Found in the Keokuk Group, at Keokuk, Iowa, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of D. G. Anderson, of Keokuk, Iowa, from whom this specimen was obtained.

CYATHOCRINUS TUMIDULUS, n. sp.

Plate III, Fig. 7, view opposite the azygous side. Specimen somewhat flattened and the ends of the arms broken away.

Species medium size and bearing very heavy arms. Calyx low, basin shaped; sutures depressed; surface granular.

Basals small and apparently hidden by the column in the concavity of the lower side of the calyx, though, as our specimen is depressed, it is probable that the basals may be seen in a better specimen extending slightly beyond the column. Subradials large and remarkably tumid, being roughly hemispherical externally. First radials a little smaller than the subradials, tumid, transversely angular in the middle part and truncated the entire width above. Second radials quadrangular, transversely angular in the middle part, and more than twice as wide as high. Third radials in four of the rays pentagonal, axillary, and supporting upon each of the upper sloping sides a single arm. The ray opposite the azygous area consists of a single arm, which commences on the first radial with a quadrangular plate as in the other series. This gives to the species only nine arms.

The first azygous plate truncates a first radial and extends nearly as high as the first radials, and has a short upper side on which rests a smaller plate.

Arms long, coarse, rough, and composed of short, more or less cuneiform plates, projecting on alternate sides above for the reception of short, stout pinnules.

This species is remarkable for the tumid subradials, large, rough arms and short, stout pinnules. The calyx is that of a *Cyathocrinus*, but the arms and pinnules resemble those in some species of *Scaphiocrinus*. This species is so different from any hitherto described that no comparison with any of them is necessary to distinguish the species.

Found in the Keokuk Group, on Indian creek near Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

CYATHOCRINUS SIGNATUS, n. sp.

Plate VI, Fig. 10, side view of calyx and part of the arms.

Calyx small, cup-shaped, height a little more than the diameter; sides unequal; sutures distinct; plates slightly convex; surface smooth or granular; column small.

Basals form a shallow cup with sharp superior angles. Subradials rather longer than wide and about twice as large as the basals. There appears to be only four subradials, in our specimen. The plate on the right of the illustration occupies the place of a subradial and radial, while the azygous plate truncates the subradial on the right of it. Possibly the plates are anchylosed, or the specimen is abnormal. First radials unequal in size and not uniform in shape. The arm facets occupy about half the width of the plates, face outward, and the superior lateral sides of the first radials slope down to the sutures. The arms are very different from each other and divide with great irregularity, but they divide so frequently that there are more than a hundred and probably twice that many of them. They are composed of rather long pieces. The azygous plate broadly truncates a subradial and is about as large. The proboscis may be seen within the labyrinth of small arms in our specimen, where it is composed of large plates and appears to be balloon shaped. This species would seem to have its relations with *C. labyrinthicus*, though it is so different that no comparison is necessary to distinguish it.

Found in the Keokuk Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

BARYCRINUS FORMOSUS, n. sp.

Plate III, Fig. 6, azygous view of calyx, arms and column.

Species, as indicated by our specimen, rather below the medium size. Column moderate size, pentagonal and composed of alternately thicker and thinner plates. Calyx broadly bowl-shaped, twice as wide as high; plates thick, depressed laterally and at the angles, and swelling in the middle part so as to form broadly rounded radial ridges; surface smooth or very finely granular.

Basal plates forming a pentagonal disc nearly covered by the column. Subradials the larger and more tumid plates of the body, longer than wide, four hexagonal and one heptagonal. First radials wider than long, deeply sunken at the lateral angles, and each having a broadly rounded radial ridge in the middle; facets for the reception of the second radials concave, each a little more than half the width of the plate, suture gaping; superior lateral angles sharply truncated for the reception of the summit plates. Second radials short, transverse, rounded plates, a little longer in one of the rays than in either of the other three preserved in our specimen. Third radials longer than the second, axillary and supporting upon each upper sloping side heavy, strong arms.

First azygous plate large, quadrangular, wider than high, resting upon the upper side of the heptagonal subradial and separating two first radials. Second plate smaller than the first, but, in our specimen, it is turned in upon the vault so as not to expose the entire surface.

Arms ten, two from each ray; short, heavy, rounded externally, and composed of rather long slightly cuneiform plates. Every fourth plate on each side bears an armlet, that is, every second alternate plate on opposite sides bears an armlet. The intervening plates that do not bear armlets are the shorter ones. The armlets are short and stout and bear secondary armlets as in *B. spectabilis*.

The general form of the calyx and arms will readily distinguish this from other described species.

Found in the Keokuk Group, Washington County, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY POTERIOCRINIDÆ.

ZEACRINUS BELLULUS, n. sp.

Plate III, Fig. 8, calyx and arms, azygous side on the left.

Species below the average size, slightly constricted above the calyx, arms coming to a point at the summit, and the whole very neat in outline. Calyx low; plates convex; sutures bevelled; columnar cavity moderately deep; surface granular.

Basal plates within the calyx and covered externally by the column. Subradials rather large, barely visible, at the superior angles in a side view, convex and sutures distinct. First radials wider than high, convex, truncated the entire width above and separated from the second radials by a gaping suture. Second radials nearly as long as wide, convex longitudinally, depressed laterally toward the sutures, pentagonal, axillary and supporting upon each upper sloping side a single arm. However, the ray opposite the azygous area is not visible in our specimen, and it may, as in other species in this genus, bear only a single arm, and hence the species will possess only nine arms; but if it is like the other rays, the species has ten arms.

The arms are slightly fusiform and composed of a single series of plates which are transverse and nearly as long as wide, at first, but gradually become thinner and wider and cuneiform toward the middle part, and, without again shortening, they become narrower as the arms taper to the distal end. Each plate bears a pinnule directed upward and inward and composed of long joints.

The first azygous plate is twice as long as wide, has five sides, the lower end abuts upon a subradial, the under sloping side rests upon another subradial, and the upper sloping side abuts upon the under sloping side of the first radial on the right; one superior side abuts the second azygous plate, while the summit is truncated by the third azygous plate. The second azygous plate truncates a subradial. The third azygous plate is long and abuts one side upon the short lateral side of the first radial on the right and the side of the second radial and part of the first arm plate.

This species bears some resemblance to *Cyathocrinus maniformis* of Yandall and Shumard which has generally been referred to *Zeacrinus.* In that species the subradials are long and abruptly bend into the columnar cavity and upward so as to form a convex rim for the base of the calyx and show the upper part of the plates in a lateral view; in this species the columnar depression is much smaller and the subradials are comparatively shorter and only slightly convex so as to form a somewhat truncated base to the calyx and to show only the superior angles of the plates in a lateral view. The first radials are comparatively shorter and the second radials comparatively longer and the plates more convex in this species than they are in *Z. maniformis.* The arms in this species are more fusiform than in *Z. maniformis.* In that species there are only nine arms.

Found in the Kaskaskia Group, near Shoals, Martin County, Indiana, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS OBESUS, n. sp.

Plate IV, Fig. 6, side view, with the ray opposite the azygous area on the right; Fig. 7, azygous view; Fig. 8, basal view.

Body robust. Calyx very low and round; columnar cavity deep so that the point of columnar attachment is about on a line with the top of the first radials; surface smooth or granular.

Basal plates completely within the calyx. Subradials long and narrow, extending from the bottom of the columnar cavity down and over the basal rim so as to be seen in a lateral view. First radials have a long triangular extension down into the columnar cavity, and they are separated from the second radials by a transverse suture. The second radials are wide, short, pentagonal, axillary plates, in four of the series, but in the ray opposite the azygous area, it is a quadrangular plate, a little more than twice as wide as long, and followed by a shorter quadrangular plate, which is succeeded by a short, axillary plate. The second bifurcation of the rays takes place on the fourth plate, from the first axillary plate, in all the rays except two, and in these it takes place on the fifth plate. Our specimen is not preserved so as to show any further divisions of the arms, if any take place.

The first azygous plate is long and narrow like a subradial, and extends down deep into the columnar cavity, between a subradial and the under sloping side of the first radial on the right and rises a little above the subradial. The second plate truncates the subradial, separates the first radials and extends to the top of the first secondary radial on the right and to the middle of the second secondary radial on the left. It is followed by a much smaller plate, and it, in turn, by a small triangular plate.

This species is distinguished from *Z. magnoliiformis*, the type of the genus, which it seems most to resemble, in several particulars, one of which is sufficient to distinguish the species. In *Z. magnoliiformis*, the arms bifurcate on the third and fourth plates, in this species they bifurcate on the fourth and fifth plates. The azygous side of *Z. magnoliiformis* has never been illustrated and we have no specimen of that species with which to make a comparison, but, judging from the description given, in the Geo. Sur. of Iowa, Page 544, the azygous areas in the two species are not alike. The subradials have not the same form according to the illustration of that species, by Hall. Our species is more robust and the basal cavity seems to be deeper. It has some resemblance to *Z. depressus*, a diagram of part of which is in the Geo. Sur. of Iowa, Page 546, but the azygous area will at once distinguish it.

Found in the Kaskaskia Group, at Flag Pond, Virginia, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS NITIDUS n. sp.

Plate VI. Fig. 3, azygous view; Fig. 4, view of the same specimen, opposite the azygous side. The specimen is somewhat flattened.

Species below the average size, much constricted above the calyx, arms proportionally large and coming to a point at the summit. Calyx subhemispherical, base depressed; sutures distinct; surface granular.

Basal plates within the calyx and covered externally by the column. Subradials about as wide as long, sharply bending into the columnar cavity and upward so as to form a convex rim, for the base of the calyx, and to show full half the length of the plates in a lateral view. First radials about one half wider than long, truncated the entire width above and separated from the second radials by a gaping suture. Second radials of unequal length, some of them longer than the first radials and others shorter, convex longitudinally, constricted on the sides, four of them pentagonal, axillary, and supporting upon each upper sloping side a single arm; the other one, which is opposite the azygous area, is quadrangular, and has a short upper side and bears a single arm. The species, therefore, has only nine arms.

The arms are short, comparatively large, very slightly fusiform and composed of a single series of short plates, that are more or less cuneiform in the middle part of the arms. Each plate bears a pinnule directed upward and inward, which is composed of long joints.

The first azygous plate is quadrangular, a little longer than wide, placed oblique, the lower end abuts upon a subradial, the under sloping side rests upon another subradial, the opposite side abuts the under sloping side of the first radial on the right, and the superior side abuts upon the second azygous plate. The second azygous plate is larger than the first, truncates a subradial, and occupies almost the entire width of the azygous area. The third azygous plate is quite small and does not seem to extend to the first plate.

It is quite unnecessary to compare this species with *Z. bellulus*, above described, but it may be compared with the form figured by Hall, as *Z. maniformis*, which it very much resembles. Hall's specimen, however, bears only a slight resemblance to *Z. maniformis* as figured by Yandall & Shumard, in their contributions to the Geology of Kentucky, and we prefer to compare our species with that which is the true *Z. maniformis*. *Z. maniformis* has proportionally a longer and more globose calyx and much longer arms than our species. The second radials in our species are much more constricted on the sides than they are in *Z. maniformis*, and we are led to infer, from the figure, that it had ten arms while our species has only nine.

Found in the Kaskaskia Group, in Randolph County, Illinois, and now in the collection of Wm. F. E. Gurley.

SCAPHIOCRINUS MARTINENSIS, n. sp.

Plate IV, Fig. 9, Calyx, part of the column, and part of the arms.

Calyx cup-shaped, more than one and a half times as wide as high, very evenly expanding from the column to the top; sutures distinct; surface smooth or finely granular. Column small, round and composed of alternately thicker and thinner pieces.

Basals form a little cup, with sharp, high angles, at the top. Subradials twice as large as the basals. First radials larger than the subradials, wider than high, truncated nearly the entire width for the second radials, from which they are separated by a gaping suture. The upper part below the gaping suture is quite prominent and convex in the middle part, and the superior lateral angles are slightly truncated, leaving the suture at the top depressed. The second radial or first brachial, in the only arm preserved, in our specimen, has a length greater than the diameter at the upper end, and the second brachial is longer than its greatest diameter, axillary, and supports an arm upon each upper sloping side. The two brachials together, are round externally and contracted on the sides.

The arms are short and coarse, one of them divides on the seventh plate and the other remains single throughout its length. The arms are composed of remarkably long, cuneiform, alternately projecting plates, that bear alternately, short, strong, long-jointed pinnules. Only pieces of the other arms are preserved, in our specimen, but one of them is shown to have had only a single brachial, which is long, contracted in the middle, at the sides, and axillary. The arms are not, therefore, uniform in structure. The azygous side is not visible.

This species is so different from any hitherto described, that no comparison with any of them is necessary, in order to distinguish it.

Found in the Kaskaskia Group, in Martin County, Indiana, and now in the collection of Wm. F. E. Gurley.

SCAPHIOCRINUS ARROSUS, n. sp.

Plate VI, Fig. 5, azygous view of calyx and arms.

All the plates of the calyx and arms are angular and present a very rough aspect. The plates of the calyx, though small, are deeply sculptured. The calyx is low, less than half as wide as high. The column is obscurely pentagonal, and composed near the calyx of thin plates radiately furrowed near the outer circumference.

Basals small, hidden by the column. Subradials small, wider than high, directed outward, hexagonal, except the one on the azygous side, which is truncated at the top and heptagonal, each one is produced into an angular node, at the central part. First radials pentagonal, about half as high as wide, sharply angular, or having a ridge at the upper part and a radiating ridge from the central part to each adjoining subradial. Horizontally truncated the entire width of the plate on top, where the suture is gaping. Second radials quadrangular, about half as long as wide, sharply angular in the central part; sutures gaping. Third radials pentagonal, nearly as high as wide, axillary, sharply angular in the central part, upper sides very steep and each supporting an arm.

The bifurcation of the arms is not uniform, in the different rays. The one on the left of the azygous area bifurcates on the fourth plate, while the four on the right of the azygous area bifurcate on the sixth plate. One of the arms does not bifurcate again, but the other one bifurcates once, though not at uniform distances from the first bifurcation. This method of dividing the arms gives to the species, in the upper part, thirty arms. The arms are angular externally, and composed of slightly cuneiform plates that bear coarse pinnules.

The azygous plates are sculptured, the central part of each being most prominent, and arranged in alternate order, the first one is inserted obliquely between the subradial and a first radial.

The calyx of this species resembles the calyx of *Scaphiocrinus bonoensis*, but the arms are not half as numerous and are wholly different, after the first division. We do not know of any other species with which it is necessary to compare it.

Found in the Keokuk Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

HYDREIONOCRINUS SANCTILUDOVICI, Worthen.

Plate VI, Fig. 2, view of the type.

Prof. Worthen, in Volume VIII of the Geo. Sur. of Illinois, page 98, gave a short description of this species, under the name of "*Eupachycrinus sanctiludovici,*" but did not illustrate it. We have figured the type of the species, which is very fragmentary, as stated by Prof. Worthen, but from the expanded summit of the vault and the short, strong spine, shown on the right of the illustration, we suppose it to belong to the genus *Hydreionocrinus*, to which we have referred it. It occurs in the St. Louis Group, at St. Louis, Missouri, and from his imperfect description and our illustration, the species may be identified.

HYDREIONOCRINUS SUBSINUATUS, n. sp.

Plate VI, Fig 11, azygous side view of the calyx; Fig, 12, basal view of same specimen; Fig. 13, azygous side view of another specimen, preserving part of the spinous second radials; Fig. 14, basal view of same specimen.

Calyx depressed, saucer-shaped, slightly concave below, longitudinally concave on the ventral side; sutures distinct; surface smooth. When viewed from above or below, hexagonal, in outline, by reason of the truncated first radials, and the concave, wide azygous area. Column round.

Basals form a pentagon one-half wider than the column, with a central, columnar cavity surrounded by an external rim, for the support of the attaching column. Subradials of moderate size, three of them apparently pentagonal, though as each one abuts upon two basals, where there is an obsure angle, they are really hexagonal. The two adjoining the azygous area are heptagonal. They curve very slightly down to the basals, and upward, toward the acute angles between the first radials. They are not uniform in size or shape; the heptagonal plate on the right of the azygous area is the wider, and the one on the left the longer one. First radials twice as wide as high, truncated the entire width above, much thickened within, and separated from the second radials, on the outer face, by a gaping suture, but immediately within, a straight ridge extends from one outer angle to the other having a furrow on each side so as to form a hinge on which the second plates articulate; behind this hinge in the middle part of each plate, there is a socket for the reception of a tooth-like projection. Second radials short and heavy and produced externally in a moderately strong spine.

First azygous plate longer than wide, pentagonal, upper side short, abutting below on a subradial and resting very slightly oblique between another subradial and the under sloping side of the first radial on the right. Second azygous plate longer than wide, truncates a subradial, abuts upon the superior lateral side of the first radial on the left, and the first and third azygous plates on the right. Third azygous plates longer than wide, truncates the first azygous plate, and abuts upon the superior lateral side of the first radial on the right. The second and third azygous plates are hexagonal, but the plates abutting the superior side are not preserved in our specimens. A small part of a proboscis is preserved in one of our specimens, that shows some heavy, transversely furrowed plates. Other parts not preserved.

This species is so different from any other referred to this genus, that no comparison will serve further to distinguish it. There is a possibility that it is a *Zeacrinus*, but we think it is not.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

HYDREIONOCRINUS NODULIFERUS, n. sp.

Plate VI, Fig. 15, view opposite the azygous area; Fig. 16, azygous view of the same specimen; Fig. 17, basal view of the same, showing the protruding part of the second radials.

Calyx bowl-shaped, twice as wide as high; columnar cavity abrupt; plate gently convex; sutures slightly beveled; surface granular. Column round.

Basals sunken in the columnar cavity and only slightly larger than the diameter of the column. Subradials of moderate size, four of them apparently pentagonal but really hexagonal, because of abutting two basal plates, one of them heptagonal, by reason of being truncated by the second azygous plate. The lower ends curve abruptly into the columnar cavity and the superior ends more gently upward toward the acute angles between the first radials. First radials one-third wider than high, truncated the entire width above, thickened within and separated from the second radials, on the outer face, by a gaping suture, but immediately within, a straight ridge extends from one outer angle to the other, having a furrow on each side, so as to form a hinge, on which the second plate articulates. Second radials of three kinds; the one opposite the azyous area is twice as long as wide, rounded externally, contracted in the middle, serrated or bearing small nodes at the lower end, where it projects beyond the first radial, and axillary at the superior end, where it bears two arms. The plates on each side of the azygous area are of the same form but shorter and project farther beyond the first radials, where the nodes are stronger, and the central one almost spine-like. The two lateral second radials are still shorter, having a width and depth, each, greater than the length, and projecting still more beyond the first radials, showing a remarkably wide gaping suture. The central nodes are really small spines. Each second radial bears upon the upper sloping sides two arms which make ten arms in this species.

The arms are composed of a single series of rather long plates, each one of which bears a central tubercle or node.

The first azygous plate is quadrangular and rests between a subradial and the under sloping side of the first radial on the right. It does not appear to abut upon a subradial below, but comes to a point near the angle. The second azygous plate truncates a subradial and rests between the superior lateral side of the first radial on the left and the upper sloping side of the first azygous plate on the right. The third azygous plate truncates the first and abuts against the very short lateral side of the first radial on the right. The second radials and the arms are quite different from anything heretofore described and will serve to distinguish it from all other species. Possibly, it may belong to *Zeacrinus*, though it has no close resemblance to any species described, in that genus. The summit of the proboscis will determine whether it belongs to *Hydreionocrinus* or *Zeacrinus.*

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

HYDREIONOCRINUS CRASSIDISCUS, n. sp.

Plate VI, Fig. 18, basal view; Fig. 19, azygous side view of the calyx.

Calyx discoid, slightly concave below, plates convex; sutures distinct, surface granular. Column round.

Basals form a pentagon one-third wider than the columnar cicatrix, which is concave and radiately furrowed, for the support of the attaching column. Columnar canal very small. Subradials directed horizontally, convex, of unequal size, the one on the right of the azygous area being the larger and wider one; each one is hexagonal. First radials twice as wide as long, convex, sutures depressed, directed almost horizontally, so as to give the calyx a height little if any more than the thickness of the plates; separated, on the outer face, from the second radials, by a gaping suture, but immediately within, a straight ridge extends from one outer angle to the other, having a furrow on the outside and depression on the inside so as to form a hinge on which the second radial plates articulate. Second radials not preserved in our specimen.

First azygous plate quadrangular, longer than wide, resting between a subradial and the first radial on the left, and the under sloping side of the first radial on the right. The lower end does not reach the second subradial, as is usual in this genus. Second azygous plate longer than wide, truncates the first azygous plate, and separates the superior lateral sides of the two adjoining first radials. The third azygous plate barely touches a first radial.

Other parts of this species unknown, but the calyx is so different from any other described species that no comparison is necessary to distinguish it.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

HYDREIONOCRINUS GRANULIFERUS, n. sp.

Plate VI, Fig. 20, azygous side view of calyx and one second radial; Fig. 21, basal view of same specimen.

Calyx bowl-shaped, about twice as wide as high, concave at the azygous area, columnar cavity abruptly depressed, sutures distinct; surface very granular; column round.

Basals sunken and nearly covered by the column. Subradials curved abruptly into the columnar depression and almost as rapidly up toward the acute angles, that extend high between the first radials; three hexagonal, the other two heptagonal; all the angles are depressed, as in *Barycrinus*. First radials twice as wide as high, truncated the entire width above, much thickened within, and separated from the second radials, on the outer face, by a gaping suture, but immediately within, a straight ridge extends, from one outer angle to the other, having a furrow on each side, so as to form a hinge, on which the second radials articulate; behind the inner furrow, in the middle part of each plate, there is a notch for the arm furrow, and immediately in front of the notch there is a node that seems to have been for a socket in the succeeding plate. Second radials nearly twice as wide as high, concave in the middle, pentagonal, axillary and supporting on the upper sloping sides the free arms.

First azygous plate twice as long as wide, pentagonal, abutting below against a subradial, and resting obliquely between another subradial and the under side of the first radial on the right. Second azygous plate twice as long as wide, truncates a subradial and abuts upon the superior lateral side of the first radial on the left, and the first and third azygous plates on the right. Third azygous plate about as long as wide, truncates the first azygous plate and abuts upon the short superior, lateral side of the first radial on the right.

The arms and proboscis are not preserved, but there is little doubt about the generic reference, and the species is so marked, that it is unnecessary to compare it with any other for the purpose of distinguishing it.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

FAMILY DICHOCRINIDÆ.

TALAROCRINUS TRIJUGIS, n. sp.

Plate III, Fig. 9, basal view; Fig. 10, summit view; Fig. 11, view opposite the azygous side.

General form of the calyx and vault subelliptical. Calyx globose, truncated below; plates convex; sutures depressed; surface smooth.

Basals pentagonal and forming a very low cup or disc, one-fourth the height of the calyx, with a subelliptical columnar depression having a small circular facet for the articulating end of the column. First radials large, convex, as wide as high, four are nearly of the same form and rest on straight edges of the basals, while the other one rests in the obtuse angle formed at the union of the two basals, the summit supports two very short, double, second radials, in the middle two-thirds of its width, and one side of an interradial, on each, slightly oblique, superior, lateral edge. There are two double arm openings to the vault over each first radial plate, or one double arm opening over each short double second radial. Hence there are four arm openings to each radial or twenty small arms in the species.

A small, regular interradial rests between the superior lateral sides of the first radials and separates the short second radials and unites with the plates of the vault. The first azygous plate is in line with the first radials, it is larger and longer and extends above the top of the first radials. It supports a range of three plates, as near as can be ascertained from our specimen, which are followed by plates of about the same size to the azygous opening at the top of the vault.

The vault is elevated at the arm openings and sharply depressed at the interradial spaces. The arm openings are directed obliquely downward. The summit of the vault is convex with three elevated subspinous plates in the center, and otherwise covered with polygonal, convex and spinous plates. A spinous plate is over the line that separates the double arm opening in each of the five radial series. The azygous opening is near the margin.

This species is the same mentioned in Volume V, page 537, of the Geological Survey of Illinois, under the name of "Dichocrinus cornigerus, Schumard?" and the calyx of which is figured, under that name on plate 20, Fig. 6a, 6b, and 6c. The calyces of the two species, though somewhat different, resemble each other, but the resemblance disappears when the calyx and vault are found together. In *T. cornigerus*, the vault is much larger than the calyx and constructed on a different plan from the vault in this species so that the vaults could not be mistaken for each other, in any case. In this species the calyx is larger than the vault, and the depressed interradial spaces and prolonged radial areas are peculiar. The azygous areas have little resemblance in the two species.

Found in the St. Louis Group, at Rose Claire, in Hardin county, Illinois, and now in the collection of Wm. F. E. Gurley.

Family TAX~~I~~OCRINIDÆ.

Forbesocrinus pyriformis, n. sp.

Plate IV, Fig. 1, view of an almost entire specimen.

General form of the calyx and arms, together, subovate or somewhat pear-shaped, which suggested the specific name. The column is round, large and tapers rapidly from the calyx, where it is composed of very thin plates.

The calyx constitutes more than half the length of the body, it is wider than high and somewhat obconoidal or funnel-shaped above the column. The plates are convex. The interradial areas are long and narrow, slightly flattened and depressed below the radial series, which are gently rounded.

Basal plates not observed. Subradials rather small. Primary radials twice as wide as high, convex on the outer face, pentagonal, hexagonal, or heptagonal, depending upon the number of interradials that abut upon them laterally; four in each of four series and only three in one of the lateral series; concave on the upper sides, immediately below which, they are most protuberant. The upper plates slightly overlap the next lower ones, in the middle part, though not by a little toothlike projection, as in *Forbesocrinus agassizi.* This projection is described as a distinct plate and called a "small patelloid plate," by Hall, in the Geological Report of Iowa, vol. 1, pt. 2, p. 631, and we find that error, in respect to *F. agassizi*, transferred to the definition of the genus, in the "Revision of the Palæocrinoidea," by Wachsmuth & Springer, page 51, where they say "The sutures of the radial and arm plates strongly sinuate, and partly occupied by additional patelloid plates." The toothlike projection, in *Forbesocrinus agassizi*, is not a separate plate; there are no patelloid plates in any species of *Forbesocrinus*, and it is not too much to say, they have no existence, in any known species of the Palæocrinoidea. They did not belong to the economy of that order of animals.

There are three secondary radials in each series, each one is twice as wide as high, and, though hexagonal, and heptagonal, and of the same general form, as the first radials, they are much smaller. The upper concave faces of the third secondary radials incline less, from the central apex, than they do in the axillary plates of the primary radials. The tertiary radials vary in number, from five to nine, in the different series, they are thinner and proportionally wider than either of the lower series, and being located, at the greatest circumference of the body, they are arranged transversely, instead of being inclined to the right and left, as in the primary and secondary series. The next division takes place, in one-half of the rays, from the seventh to the tenth plate, but no division is shown to take place, in our specimen in the other half of the rays, notwithstanding one of them is preserved as far as the sixteenth plate. In the higher rays, the plates are thin and transversely arranged, but the upper face of each one is moderately concave, and, in the middle part, slightly overlapped by a projection from the next succeeding plate, as in the primary and secondary series. The transverse, arcuate sutures are distinct and the slight overlapping does not destroy the depression, but, on the contrary, it is correspondingly depressed. There are, in the upper part, therefore, sixty arms.

The interradial areas are not of exactly the same shape, nor are they filled with exactly the same number of plates, though they have elongated, subovate, or lance-subovate outlines, pointed above. There are from eighteen to twenty-five plates, in each regular interradial area, but, on account of an injury to our specimen, at the azygous interradius, the number of plates in that area cannot be counted. The first regular interradial plate rests between the upper sloping sides of the first primary radials; in some areas it is followed by one plate, and in other areas, two plates abut against it; in one area, it is as large as any of the succeeding plates, while in other areas, there are from one to four larger plates above it; in the widest part of one of the areas, there are only two rows of plates, while in the others there are three. The plates, however, become smaller toward the top of each interradius. The intersecondary areas are of the same general form as the interradial areas, but much smaller, and contain from eight to twelve plates. In the intertertiary areas there are two or three small plates in line, one above another.

This species is distinguished from others, by its general form, comparative length of the calyx, structure of the rays and the interradial areas.

Found in the Keokuk Group, at Muldrough's Hill, Hardin County, Kentucky, and now in the private collection of Wm. F. E. Gurley.

TAXOCRINUS CRAWFORDSVILLENSIS, n. sp.

Plate IV, Fig. 3, lateral view of calyx, arms and part of the column.

This species so much resembles what we suppose to be *Forbesocrinus multibrachiatus* of Lyon & Casseday, that we will follow the definition of their species, as near as practicable, in order that the distinguishing differences, if they are of specific importance, may be made more prominent. *F. multibrachiatus* was not illustrated by the authors, and, as they may have included more than one species in their definition, exactly what was described may be somewhat doubtful. They were both good palæontologists and their descriptions, generally, were unexceptionable, but in this case, they gave Clear Creek, Hardin County, Kentucky, Washington County and Montgomery County, Indiana, as the typical localities for their species, and as we are quite sure no single species of *Forbesocrinus* or *Taxocrinus* was ever found at the three localities, we are left in doubt, as to what should be included under their specific name. White described a form, as *T. multibrachiatus var. colletti*, from Crawfordsville, which is certainly distinct from *F. multibrachiatus*, and, we think, it should be raised to the rank of a species, under the name of *T. colletti*. The difference between the genera *Forbesocrinus* and *Taxocrinus* are so poorly marked that it is not easy to say to which genus such species as we have here under consideration really belong, though we are inclined to think that our species should be referred to *Taxocrinus*, on account of its azygous area. Otherwise, we would refer it to *Forbesocrinus*.

In describing their species they say "Body subglobose where the arms are folded inward". This applies as well to our species. They say "From the base to the free arms somewhat discoid"; this we do not understand, because we do not suppose the arms become free until they passed the interradial plates, and we think their species agreed with ours in this respect. They say "Robust, externally covered with minute granules. Basal pieces three, similar in form and size; forming by their outer margins apparently the upper joint of the column, slightly thickened opposite the middle of the pieces. Subradial pieces five, in good specimens presenting five obtusely angular pieces disconnected with each other, resting apparently upon the supracolumnar piece." All these parts are not visible in our specimen, but, if we understand them correctly, the two species may agree in these respects.

They say "Radial pieces, first series, generally, four in each ray, the first five resting between the angular points of the subradials are regular in size and form, four are irregular hexagonal, twice as wide as high, the fifth pentagonal and much smaller than either of the others. The second and third radials are obscurely hexagonal, similar in form, differing slightly in size; the fourth is axillary, obscurely six-sided, rising into a long, angular point; on each of its oblique upper sides supporting three pieces of the secondary radials, which are similar in form and nearly as large as the first radials". Much of this will apply to our species, but we think the three secondary radials in each series, in our species, are much smaller than the primary radials.

They say "The last of these being axillary support on their upper oblique margins from four to seven brachial pieces." In our specimen the ray on the left and the ray on the right of the azygous area have each eight of these brachial pieces, and another ray shown on the right side of the illustration has ten, and another on the left of the illustration has ten. And from this part to the end of the arms the number of plates do not agree in the two species, though there are sixty arms in each species.

In their species there are fifteen regular interradials, as follows: One, followed by two in the second range and three in the third range, above which there are only two in each range or 5x2. In our specimen, in the only regular interradial area in which the plates can be counted, there are eighteen, as follows: One, followed by two in the second range and three in each of the next four ranges, above which three plates may be seen. We have an impression, however, that the number of plates in the interradial areas is not uniform.

In their species there are from six to seven secondary interradials and from three to five tertiary interradials. In our species there are from five to seven secondary interradials, but no tertiary interradials.

In their species there are six azygous plates in the order of one, two, one, two. In our species the azygous area is larger than the regular interradial areas and has a series of five long longitudinally convex plates, in the middle of the area, resting upon the truncated upper side of a basal plate, and extending as high as the third secondary radial, and, on each side of this ridge of plates there are several smaller polygonal plates, and others extending beyond. There is, therefore, no resemblance between the azygous areas in the two species.

The radial plates, in both species, as is usual in this genus, are concave on the exterior part of the upper sides and slightly overlapped, in the concave part, by the succeeding plates.

Their species, therefore, would seem to be more globose than ours, by reason of the wider secondary radials and presence of intertertiary radials. Our species has more tertiary radials than theirs, differs in the number and position of the regular interradials, and is so widely different, in the azygous area, that it alone will distinguish the species.

We have never seen a specimen, which we knew belonged to *F. multibrachiatus*, and we suppose it is because their type came from Clear Creek, Hardin County, Kentucky, and there has been error in referring other species to it.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

ONYCHOCRINUS PARVUS, n. sp.

Plate IV, Fig. 5, azygous side view.

Species very small. Calyx rather high, basin shaped; plates smooth; sutures distinct. Column round and composed of moderately long plates near the calyx.

Basals extend beyond the column, but our specimen is injured at the basals so the exact outlines are not shown. Subradials about half as large as the first radials and nearly as long as wide. One of them is concave on the upper face for the reception of a small azygous plate. The first radials are wider than long and truncated more than half the width for the second plate, which is the first plate in the free arms. The arms bifurcate on the third plate (or the fourth in the radial series). The arms are round externally and the plates more than half as long as wide; sutures transverse. The first armlet is thrown off from the second plate after the first bifurcation. Only a single azygous plate is preserved in our specimen and it is slightly out of place. No regular interradials are preserved.

This species is so much smaller than any heretofore described that no comparison with any of them is necessary to distinguish it.

Found in the Kaskaskia Group, at Shoals, in Martin county, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY EUCALYPTOCRINIDÆ.

EUCALYPTOCRINUS WORTHENI, n. sp.

Plate IV, Fig. 2, lateral view.

The arms in the specimen illustrated are drawn away from the summit about half an inch, which gives them a bushy or broom-like aspect; if they were replaced between the interbrachial plates and closed, at the top, the general form of the body would be ellipsoidal.

Body medium size, with arms and interbrachials in place, ellipsoidal in outline; surface of the plates granular.

Calyx a little more than one-third the entire length of the body, bowl or urn-shaped, wider than long; sutures distinct. Column round, medium size. Basals developed in the interior.

First radials rather large, rapidly expanding, and one-third wider than high. Second radials nearly square, being only a little wider than high. Third radials rather larger than the second, heptagonal, greatest width at the union of the superior and inferior sloping sides. First secondary radials pentagonal, about two-thirds as large as the third primary radials. Second secondary radials, short, about one-third as large as the second, expand upward, somewhat like an inverted frustum, and support the tertiary radials upon the upper slightly sloping sides. There are three short quadrangular tertiary radials below the summit of the interradials, and then the free arms commence with one or two cuneiform plates followed by interlocking ones, which maintain a somewhat uniform size, until they taper at the summit, where the solid interbrachials unite around the orifice. The arms being thrown out from between the interbrachials, in our specimen, probably, causes them to appear larger than they would if they were in place. They are somewhat crystalline and the sutures are more or less obliterated, and, therefore, the interlocking plates may be indicated, in the illustration, rather larger than they should be, but if so it is very little.

The first interradial is a large ten-sided plate, quite as large as the second and third primary radials together, and slightly longer than wide. It is followed by two long narrow plates that extend to the top of the third tertiary radials. The intersecondary radials are single, truncate the third primary radials, have the form of the two small interradials when united, but smaller than the two together. The solid interbrachials are rather thick below and gradually become thinner in their upward extension and unite at the summit, with each other and with the small plates that surround the orifice.

This species is distinguished from others by its general form, and when compared with *E. crassus*, which it may be said to most resemble, the calyx is proportionally much shorter, and more uniformly rounded and bowl-like, and the tertiary and secondary radials are wholly different in form and in position.

Found by Prof. A. H. Worthen, in the Niagara Group, in Wayne county, Tennessee, and now in the State Museum, at Springfield, Illinois. The specific name is in memory of the late distinguished State Geologist of Illinois.

FAMILY RHODOCRINIDÆ.

GONIASTEROIDOCRINUS LYONANUS, n. sp.

Plate IV. Fig. 4, view of the vault and lateral prolongations.

This species is founded upon the vault and lateral prolongations of the specimen illustrated. It is quite different from anything heretofore described or illustrated, and, therefore, deserves illustration and definition. Whether or not one is justified in giving a specific name to such a fragment is a question not so readily answered. A specific name should not be an obstacle in the way of progress, in palæontological learning. It requires neither information nor study to propose specific names, and when improvidently or unjustifiably proposed, they should not be recognized. We think, as a general rule, a specific name should never be given to a specimen, when, from its definition, another who may happen to find a better specimen, in rocks of the same age, cannot determine whether or not it belongs to the same species. We have here, however, a very complete part of the body of a peculiar crinoid, about the generic relations of which there is no doubt, and, we suppose, whenever the calyx is found, after our definition of this part, that one may readily determine that it belongs to this species, and it is for that reason we have felt warranted in giving to it a specific name.

Species rather small. Vault composed of small polygonal plates. Central part of the vault only slightly raised above the lateral margin and composed of the larger plates. Instead of a single proboscis arising from the center of the vault, as in many palæozoic genera, there are six lateral prolongations, five of which bifurcate, and one tapers to a point without a bifurcation. There is a shallow, subovate depression, within the margin, opposite each one of the five bifurcating lateral prolongations, but none opposite the single prolongation. Within one of these depressions, near the center of the vault, there is a small orifice surrounded with small plates—the anal opening of some authors, and the mouth of others. Beneath the plates of the vault there are channels passing between the depressions, meeting centrally, and connecting with each of the prolongations; two small channels enter the bifurcating prolongations, but only one is extended through the single branches, and it does not open externally. It will be observed, that the marginal plates of the vault are continued upon the lateral sides of the bifurcations, except in the case of the single prolongation, and it is evident the marginal circulation entered these prolongations, and also connected with the central circulation, through the channels above referred to. The functions performed by these lateral prolongations are, therefore, not essentially different from those performed by the proboscis in other genera. There is a slight elevation, within the margin, opposite the single prolongation, and from this point only a single channel seems to have entered the prolongation or unyoked feature of this vault. The arms connected with the body immediately below the rim of the vault, and some of the fragments of the arms are preserved on our specimen, though not illustrated. They are small and composed of a double series of interlocking plates bearing small pinnules.

This species is distinguished from others known to the authors by the spreading of the bifurcating prolongations, instead of their curving around, so as to cross each other, and by the single extension which is not known, by us, to exist in any other species. It is so different from the type of this genus, and from all defined species from rocks of the same age, that no comparison with any of them is necessary.

Found in the Keokuk Group, on Indian Creek, near Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of one of the authors of the genus, the late distinguished palæontologist, Sidney S. Lyon.

FAMILY EUPACHYCRINIDÆ.

ULOCRINUS BLAIRI, n. sp.

Plate V, Fig. 16, azygous view; Fig. 17, basal view, Fig. 16, view opposite the azygous area.

This is the largest known species in this genus. The calyx has a height of nine-tenths of an inch and a diameter of one and seven-tenth inches, being nearly twice as wide as high. The base is very gently rounded to the middle of the subradials, above which the calyx is almost cylindrical. There is no columnar depression; the plates are plain, and slightly beveled at the sutures; surface granular.

The basals form a large, very gently convex, pentagonal disc, three times as wide as the diameter of the column. The column is round, and there is an impressed cicatrix, in the basal plates, where the column is attached, by radiate denticulations, near its outer circumference. Columnar canal, pentagonal, and having the ends of the rays rounded. Subradials about as large as all the basals together, a little wider than high, but if the plates were straightened the width and length would be about equal. Four of them hexagonal, by reason of uniting with two basals, where the angle is obtuse, the other one, which supports the second azygous plate, heptagonal. They rapidly curve upward in the middle part and extend an angle upward one-third the height of the first radials. First radials pentagonal, about one-half wider than high; the superior face is the full width of the plates, and extends internally about one-fourth the diameter of the calyx. The sutures are gaping, but, immediately within, a straight and furrowed ridge extends from one angle of the plates to the other, so as to form a ridge on which the second radials articulate.

The first azygous plate is quadrangular and rests obliquely between a subradial and the under sloping side of the first radial, and abuts the lower side against another subradial, and the superior side against the second azygous plate. Second azygous plate is more than half as large as the first, truncates a subradial and rests an under sloping side against the first azygous plate and separates two first radials. Other parts unknown.

This species is so different from either of the others that have been described that no comparison with any of them is necessary to distinguish it.

Found by R. A. Blair, in the Upper Coal Measures, near the line of Kansas and Missouri, southwest of Sedalia, and now in the collection of S. A. Miller.

ULOCRINUS OCCIDENTALIS, n. sp.

Plate VI, Fig. 6, view of the basal plates, part of two being broken away; Fig. 7, interior view of the same specimen; Fig. 8, a subradial plate.

The calyx of this species is broadly rounded, at the base, without a columnar depression, gradually expands beyond the subradials, and has a length greater than the diameter. The sutures are distinct, plates moderately thick, and peculiarly denticulate, at the sides, to strengthen their union with each other; surface granular. The column is round, and there is an impressed cicatrix, in the basal plates, where the column is attached, by radiate denticulations, near its outer circumference. Columnar canal pentagonal.

Basals form a cup about one-third as high as wide. The plates are longer than wide and gently curve upward from the columnar facet. The most remarkable curiosity is their prolongation, in the interior of the calyx. They project up, in the interior, in the form of a five-furrowed, gradually expanding, thin cup, for the distance of about one-sixteenth of an inch. The columnar canal is thus expanded or enlarged within the cavity of the body, and extraordinary solid parts are developed, for muscular attachment, and to give strength to this part of the body. The length and breadth of a subradial is about equal; it is convex and gradually expands to the superior lateral angles. Other parts of this species unknown.

What we have of this species is so different from others that have been described, that no comparison is necessary to distinguish it.

Found in the Upper Coal Measures, at Gilpin, Missouri, and now in the collection of Wm. F. E. Gurley.

ÆSIOCRINUS ANGULATUS, n. sp.

Plate VI, Fig. 9, view of calyx and part of an arm and three azygous plates. The specimen is a little depressed.

Calyx bowl-shaped, twice as wide as high; broadly truncated, below; plates tumid and angular; sutures deep, most depressed at the angles; surface granular. Column round or subelliptical and the end slightly inserted in the basal plates and attached by radiating denticulations near the outer circumference. Columnar canal very small and round.

The basals form a flat, pentagonal disc about one-half wider than the diameter of the column. Subradials large; four hexagonal, one heptagonal, directed nearly horizontally from the basals so as to form a pentagonal disc around the basals. The plates are subpyramidal and angular, with the apex directed downward so as to leave about half of the plates below the level of the basal plates, and if the calyx is made to stand upon a plain, it will rest upon the apices of the subradials. The superior angles of the subradials are deeply sunken, as is usual in *Barycrinus*. The first radials are thick, heavy plates, about twice as wide as high, truncated nearly the entire width above and having the facets inclined outward at an angle of about forty-five degrees. They are convex, with a transverse obscure ridge in the central part and beveled toward the sutures. The superior face has a transverse ridge and narrow furrow near the outer margin and a broader furrow on the inside of the ridge; the inner central part is notched for an arm furrow. The superior face has the appearance of supporting a single plate, but in the part of one of the rays which is preserved, we see it supports a central axillary plate occupying about one-third of its width, and a plate on each side of the axillary plate occupying the outer part of it. Each of the lateral plates supports two interlocking plates that have an arm furrow on the inside, which indicates that there are two arms to each ray, or ten arms in the species, and that the two arm furrows unite within the axillary, second radial, so as to connect with the interior of the calyx, through the single notch or arm furrow in the first radial. A rather long, convex, azygous plate truncates a subradial and extends as high as the top of the first radials, where it is followed by two convex plates of about equal size, that articulated with the other plates.

This species differs so from other species of *Æsiocrinus* that it is with some hesitation we refer it to that genus, though the general structure of the calyx, aside from the sculpturing of the plates and sunken sutures, agrees more nearly with that genus than with any other that has been defined.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

EUPACHYCRINUS PARVUS, n. sp.

Plate VI, Fig. 22, basal view of calyx; Fig. 23, azygous side view.

This is the smallest known species, in this genus, and differs, in every particular, from all of them, except in the number and relative position of the plates of the calyx. Calyx very low, more than twice as wide as high; subpentagonal in outline, columnar cavity embracing the basals and nearly half of the subradials; sutures distinct and sunken at the angles; surface smooth.

Basal plates about one-half wider than the diameter of the column; citatrix for the columnar attachment concave, radiately furrowed, and pierced by a very small pentagonal columnar canal. Subradials the larger plates of the calyx, though not of uniform size, the one on the right of the azygous side being the larger. They abruptly bend down into the columnar cavity, where each bears one or two concave furrows as if gouged out with a small circular chisel, and abruptly curve upward and reach nearly to the top of the calyx. They are convex, externally, and the sutures are depressed, the depression being most marked at the angles. First radials twice as wide as high, pentagonal, the lower angle extending nearly to the bottom of the calyx, truncated the entire width above, and much thickened within; sutures gaping, but immediately within, a straight ridge extends from one outer angle of the plates to the other, so as to form a hinge on which the second radials articulate.

Azygous plates small, quadrangular and inserted between a subradial and the under sloping side of the first radial, on the right, and abutting another subradial. It is followed by another plate, as indicated by the notch between it and the top of the first radial on the left.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

ORDER BLASTOIDEA.

FAMILY **NUCLEOCRINIDÆ.**

NUCLEOCRINUS GREENEI, n. sp.

Plate VI, Fig. 24, side view; Fig. 25, basal view.

Body elongate, subovoid, depressed in the interradial spaces, so that, viewed from either end, it presents a five-rayed outline, obtuse at the angles; most deeply pentalobate at the base, less deeply above; greater width above the middle.

Base concave; basal plates very small and sunken below the radials. Radial plates very short, embracing the base of the pseudambulacral fields, which consists of a node in the central part of each plate. Pseudambulacral fields very narrow. Interradials extend to the summit and are centrally depressed in lanceolate outline, but no suture is discovered, by the side of this lanceolate ornamentation. Azygous interradius wider than the regular areas, most deeply sunken at the base and becoming convex or more prominent near the summit of the azygous plate than the pseudambulacra. The azygous plate occupies the entire interradius at the union with the basal plates, it becomes gently narrower above and abuts upon the outer half of the azygous orifice. The interradial plate is very narrow on each side of the azygous plate, pointed at the lower part, and surrounding the azygous orifice above, it reaches the summit.

Found by G. K. Greene, in whose honor we have proposed the specific name, in the Upper Helderberg Group, at Louisville, Kentucky, and now in the collection of Wm. F. E. Gurley.

NUCLEOCRINUS VENUSTUS, n. sp.

Plate VI, Fig. 26, azygous side view; Fig. 27, summit view of same specimen from Louisville; Fig. 28, side view; Fig. 29, basal view of same; Fig. 30, side view of another specimen, all from Columbus, Ohio.

Body elongate, subelliptical, flattened or slightly concave in the interradial spaces, obtusely rounded at the pseudambulacra; greatest width about the middle.

Base nearly flat. Basal plates slightly convex. Radials rather long and embracing the lower end of the pseudambulacral fields, and the node, which terminates the pseudambulacra, in the central part of each plate. Pseudambulacral fields narrow, uniform, in width, and separated by a sharply angular depression. Interradials extend to the summit and are centrally depressed in lanceolate outline, but no suture has been discovered, by the side of this lanceolate ornamentation, to show that it is a plate, as described by Lyon, in the Geological Survey of Kentucky. Possibly the sutures are anchylosed. This lanceolate depression has a fine, longitudinal furrow, in the center. On each side of the lanceolate depression the surface is beautifully ornamented with longitudinal, crenulated lines.

Azygous interradius a little wider than the regular areas, and the azygous plate stands out prominently beyond the pseudambulacra toward the summit. The longitudinal, lanceolate depression on the azygous plate, that would seem to correspond with the lanceolate depression, in the regular areas, does not correspond with the outline of the azygous plate. On the contrary, the azygous plate is considerably larger and occupies fully two-thirds of the whole azygous interradius. The sides are beveled downward from the azygous opening to the suture line and the summit is notched for the orifice. The interradial plate in the azygous area is narrow on each side, pointed in the lower part, notched for the azygous orifice and reaches the summit. The surface is ornamented as in the regular areas.

There are two elongated apertures, at the summit of each pseudambulacra, which are indicated by a raised rim in the adjoining interradials. The central part of the summit is covered by numerous plates.

Figs. 26 and 27 represent a specimen from the Upper Helderberg Group, at Louisville, Kentucky, in the collection of Wm. F. E. Gurley; and Figs. 28 to 30, two specimens from the Upper Helderberg Group, at Columbus, Ohio, in the collection of S. A. Miller. Several other specimens have been examined and the forms from Columbus, Ohio, are somewhat rounder and a little more evenly elliptical than those from Louisville, but otherwise, they appear to be alike and we are disposed to refer them to the same species. It will be readily distinguished from *N. lucina* by the less pentalobate form, longer radial plates and different surface ornamentation. It is, in all its parts, a distinct species. It will be distinguished from *N. angularis*, by the narrower azygous interradius, and much less angular outline, when viewed from any direction, beside it is proportionally a much longer form.

FAMILY GRANATOCRINIDÆ.

GRANATOCRINUS SPHÆROIDALIS, n. sp.

Plate VI, Fig. 31, summit view; Fig. 32, basal view; Fig. 33, lateral view, but the artist overlooked the interradial sutures.

Body small, subsphæroidal, moderately sunken in the interradial areas, so as to give it a pentalobate aspect; greatest width, at the upper third, where the diameter is greater than the length; broadly truncated above and concave in the central part; truncated below, and, when placed on its base, will rest on the distal ends of the ambulacra; columnar facet large.

Basal plates small and extend only slightly beyond the column. Radials extend about two-thirds of the length of the body, with distinct lateral sutures. Regular interradials one-third the length of the body and strongly incurved above. Azygous interradial stands nearly upright, above the level of the summit of the other parts of the body, where it is pierced with the azygous orifice. Pseudambulacra very gently expand, from the base to the summit, and are distinctly convex above the thin margins of the radials on each side. Pore pieces about thirty-three on each side of a well defined mesial furrow, along which their inner ends are crenate and from which they are directed obliquely downward. Summit has a rather large central five-rayed opening. Ovarian apertures large and situated on each side of the point of each interradial piece, two of them extending to the azygous orifice.

Found in the Kaskaskia Group, in Meade County, Kentucky, and now in the collection of Wm. F. E. Gurley.

GRANATOCRINUS WINSLOWI, n. sp.

Plate VI, Fig. 34, side view; Fig. 35, basal view.

Body medium size, subspherical, depressed convex in the interradial areas, evenly rounded in the middle part, longer than wide, truncated very slightly at either end ; columnar facet small; surface sculptured and tubercular.

Basal plates form a large pentagon notched by the distal ends of the ambulacra. Radials extend less than half the length of the body and have strongly defined sutures. Regular interradials more than half the length of the body and incurved at the summit. A longitudinal line of tubercles ornaments the middle of each interradial to its lower extension, which is continued as a double row, or row on each side of the radial suture, to the basal plates, and on each side of these mesial tubercles, there are one or two shorter rows of tubercles. Pseudambulacra rather rapidly expand from the base to the summit and are depressed in their upward extension below the thickened and tubercular margins of the radial and interradial plates, though, at the lower end, their convexity rises higher than the margins of the radials. Pore pieces between fifty and sixty on each side of a mesial furrow, along which their inner ends are crenate, and from which, they are directed obliquely outward and downward. The summit and azygous interradial are so injured, in our specimen, that but little can be ascertained of their characters, the ovarian openings, however, are quite small, and we are not sure that there is any more than one to each interradial plate.

The specific name is given in honor of the late Dr. J. C. Winslow of Danville, Illinois, a personal friend of one of the authors and one of the "old time" collectors, to whose patience and zeal science has been very greatly indebted.

The specimen from which this description is drawn was found in the drift at Danville, Illinois, and is in the collection of Wm. F. E. Gurley. The supposition is that it came from rocks of the age of the Burlington Group, a short distance north of Danville, which are now deeply covered with the drift.

SUBKINGDOM CŒLENTERATA.

CLASS ANTHOZOA.

ORDER ZOANTHARIA RUGOSA.

FAMILY **CYATHOPHYLLIDÆ.**

CAMPOPHYLLUM KANSASENSE, n. sp.

Plate VII, Figs. 19 and 20, calyces; Figs. 21 and 22, lateral views.

Corallum simple, short, turbinate, irregularly curved, acute at the base, and irregularly distorted in growth. Epitheca thin, with minute encircling wrinkles, interrupted only by the distortions in growth, and showing no trace of septa or dissepiments where unabraded, but if slightly worn, both septa and dissepiments are exposed plainly to view. Calyx circular, moderately deep, margin thin, from which the sides gradually slope to near the bottom of the cup, where the septa curve to the central tabulæ, and the wall as abruptly thickens. No septal fossula. From twenty-four to forty septa extending from one-third to the entire distance from the outer wall to the center. Most of them terminate before reaching half the distance to the center, but a few are shown to reach to the center. Secondary septa quite marginal and best seen when the epitheca is eroded on the outside. The tabulæ, as seen in the central area of the calyx, are flat and smooth except where penetrated by the septa. The outer vesicular zone is thin and vesicles rather large.

Our specimens are only about an inch in length, and we think they represent a small turbinate species. The species evidently belong to this genus, from the vesicular outer zone, incomplete tabulæ and short septa, but it is widely separated from *C. torquium*, the only other form yet defined, from the Coal Measures of this country, not only in size and shape, but in the internal structure and form of the calyx.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

FAMILY **FAVOSITIDÆ**.

MICHELINIA BRANNERI, n. sp.

Plate VII, Fig. 12, side view; Fig. 13, summit view.

About half the length of our specimen is covered with an epitheca; transversely, it is somewhat elliptical and the summit is convex. However, we would infer, that the species is more or less globular, ovoid or elliptical, in the upper part, and has an irregularly convex summit. The lower part expands more or less from the base, or place of attachment to some foreign object, and is covered with a dense, transversely wrinkled epitheca. The corallites are polygonal and extremely variable in size, some are minute and others are very large; they open in all directions, and some parts of the corallum are more prominent than other parts, which produces an irregular summit. The calyces are deep, and the walls are thin, even where the wrinkled epitheca unites with the corallites, the margin is exceedingly thin.

This species is evidently related to *M. eugeneæ*, but we think it is a larger species and distinguished by having larger corallites, deeper calyces, more dense and strongly wrinkled epitheca and a larger base.

Found in the Coal Measures, at Danville, Illinois, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of Prof. J. C. Branner, of Leland Stafford, Jr., University.

SUBKINGDOM MOLLUSCOIDA.

ORDER LYOPOMATA.

Family **LINGULIDÆ.**

LINGULA INDIANENSIS, n. sp.

Plate VII, Fig. 1, ventral valve.

Subovate or nearly subelliptical in outline; greatest width below the middle; length nine-tenths of an inch, greatest width six-tenths of an inch, or one-half longer than wide. Apical end somewhat truncated, anterior extremity more uniformly rounded. Sides gently convex. Valves very moderately convex in the central part and flattened near the margins. Beaks not prominent. Color, light brown or yellowish brown.

Concentric striæ very fine near the beaks, and, therefore, in the younger stages of growth but becoming coarser and more distant and somewhat undulating toward the anterior end and lateral margins.

There is no described species from Subcarboniferous rocks having the general form of this one, and it would not throw any light upon it, to compare it with subovate or subelliptical forms from Silurian or Devonian rocks.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY DISCINIDÆ.

DISCINA ILLINOISENSIS, n. sp.

Plate VII, Fig. 2, dorsal view; Fig. 3, interior of ventral valve; Fig. 4, dorsal valve of another specimen; Fig. 5, interior of dorsal valve of another specimen.

Shell large, subcircular in marginal outline, or slightly oval, longitudinally; height nearly or quite equal to one-half the diameter. Apex prominent, acute, and situated centrally or slightly posterior to the central part of the shell, and moderately incurved. The sides slope rapidly from the apex for one-third the height of the shell and then more and more gently to the margin, though, on the anterior side the shell is more compressed toward the margin than it is on the posterior part.

Surface marked by irregular radiating lines or striations, and by strong concentric elevated lines. The striæ and elevated concentric lines become more and more conspicuous toward the margin. The lower valve shows a depression on the side of the foramen, but our specimen, as shown by figure 3, is somewhat broken and pressed out of shape. The concentric lines are strongly impressed upon it.

The two specimens shown by figures 2 and 3 are from the Coal Measures, in Knox county, Illinois, and the two specimens shown by figures 4 and 5 are from Peoria county, Illinois. We refer them all to the same species, though we look upon figure 2 as the best preserved and most typical. They are all in the collection of Wm. F. E. Gurley. Figure 5 shows the interior of the upper valve and where the shell is abraded the concentric lines are strongly marked in the stone.

This species is so far removed from *Discina nitida*, that no one would be enlightened by making a comparison with it. It is more nearly related to *Discina convexa*, described from the Upper Coal Measures, in the valley of the Verdigras river, in

Kansas, and not uncommon at Kansas City, Missouri. In *D. convexa* there is a shallow depression directly under the beak, on the posterior side, which is not manifest in this species. In *D. convexa* the beak is more obtuse, less incurved, and situated nearer the posterior margin, than it is in this species. The radiating lines that ornament the dorsal valve in this species have not been noticed in *D. convexa,* beside this species seems to be the smaller of the two.

DISCINA MUNDA, n. sp.

Plate VI, Fig. 6, dorsal view; Fig. 7, lateral view of the same valve.

Shell medium size, elliptical, height less than one-third the length. Dorsal valve most convex anterior to the beak and near the posterior third of the shell, from which part it slopes regularly to the lateral and anterior margins. Beak acute and situated almost directly above the posterior margin of the shell. The shell is concave from the point of the beak to the posterior margin.

Surface jet black and marked by fine concentric lines only just visible to the unaided eye.

We know of no species with which it is necessary to compare this one.

Found in the Upper Coal Measures at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

ORDER ARTHROPOMATA.

FAMILY **RHYNCHONELLIDÆ.**

EATONIA COULTERI, n. sp.

Plate VII, Fig. 8, ventral view; Fig. 9, dorsal view; Fig. 10, cardinal view; Fig. 11, front view.

Shell medium size, longitudinally ovoid, fully as wide as long and two-thirds as thick, gradually expanding from the beaks, at first, then more rapidly, and finally broadly rounded at the sides; truncated at the anterior end. Surface marked by fine, radiating, bifurcating striæ.

Ventral valve convex from the middle toward the beak, flattened toward the antero-lateral margins and then abruptly inflected at right angles; extended in a broad, shallow, undefined, mesial depression toward the front, where it is also abruptly inflected at right angles. Beak elevated and perforated. Dorsal valve convex in the middle part and sloping in all directions, most rapidly laterally and toward the antero-lateral margins. The central part slopes least toward the anterior margin, and appears as an undefined, elevated, rounded, mesial fold, abruptly inflected at the front. Beak incurved. Margins of the valves denticulated.

This cannot be mistaken for any other defined species.

The specific name is given in honor of Prof. John M. Coulter, President of Lake Forrest University.

Found in the Oriskany Group in Jackson County, Illinois, and now in the collection of Wm. F. E. Gurley.

CLASS PTEROPODA.

FAMILY CONULARIIDÆ.

CONULARIA BLAIRI, n. sp.

Plate VII, Fig. 14, part of the surface of the upper part of the shell; Fig. 15, a specimen showing a portion of the inside of a shell, the elevated ridge shows the depression of the angles.

Shell very large, pyramidal. Angles at the four corners deeply furrowed. Lateral surfaces marked with a longitudinal, mesial line, without any furrow. Surface ornamented with transverse, smooth furrows, that are separated by low, sharp, crenate, transverse costæ; in passing across the sides, these curve forward toward the aperture, and sometimes the costæ alternate at the mesial line, at other times they cross it with slight interruption. There are from twenty-one to twenty-four costæ, in a distance equal to the width of a side. The costæ curve forward toward the aperture, in crossing the furrows, at the four corners. There are about eight crenulations, on the costæ in one-eighth of an inch, and about sixteen furrows in an inch, or about four crenulations in a distance equal to the width of a furrow, toward the apex; but nearer to the aperture there are six crenulations in a distance equal to the width of a furrow.

One side of a specimen, three and one-fourth inches long, has a diameter, at one end, of five-eights of an inch, and a diameter at the other end of one and six-eighths inches.

This is a large species and when compared with *C. gratiosa,* it will be noticed that the sides are less convex, the angles at the four corners deeper, and the furrows only half as wide, Found by R. A. Blair, in whose honor the specific name is proposed, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

CONULARIA GRATIOSA, n. sp.

Plate VIII, Fig. 1, showing two sides of a slightly compressed specimen.

Shell very large, rather rapidly expanding, from the apex, pyramidal and having subequal, lateral surfaces, which are slightly convex. Angles at the four corners moderately furrowed. Lateral surfaces marked with a longitudinal, mesial line, without any furrow. Surface ornamented with transverse, wide, smooth furrows, that are separated by sharp, prominent, crenate, transverse costæ; in passing across the sides, these curve forward toward the aperture, and sometimes the costæ alternate in the middle, and, at other times, cross the mesial line almost without interruption. There are from ten to thirteen costæ in a distance equal to the width of a side. The costæ are abruptly curved toward the aperture, in the furrows, at the four corners.

Our specimen is somewhat compressed, the four sides are quite well preserved and seem to be nearly complete at the larger end; it has a length of five inches, though one or two inches are broken away from the apical end.

This is a large and beautiful species, and will be distinguished by the convex sides, distant, crenulated, transverse costæ and wide, smooth furrows.

Found in the St. Louis Group, at Spergen Hill, Indiana, and now in the collection of Wm. F. E. Gurley.

CONULARIA SPERGENENSIS, n. sp.

Plate VIII, Fig. 2, view of a specimen, with both ends destroyed.

Shell very large, long, slowly expanding, at least, toward the larger end; subconical, and having, so far as can be observed, equal lateral surfaces. Angles at the four corners indicated by a slight, poorly defined furrow. Lateral surfaces marked with a longitudinal, mesial line, without any furrow. Surface ornamented with numerous, very small, closely crowded, transverse striæ of very nearly the same size, on all parts of the shell.

The striæ do not arch forward, in crossing the sides, as is usual in this genus, and they are not much interrupted in crossing the obscure corners or the mesial lines on the sides, indeed, it is not easy to determine from our specimen which is the forward end of it. The narrow furrows are crossed by fine lines or bars and the striæ are minutely crenate. There are about fifty transverse striæ in an inch in length.

Our specimen is more or less preserved, for five inches in length, but both ends are broken away so that no correct idea can be formed of the true length of the shell.

It is distinguished by its great length, rounded form, and surface ornamentation.

Found in the St. Louis Group, at Spergen Hill, Indiana, and now in the collection of Wm. F. E. Gurley.

CLASS CRUSTACEA.

ORDER TRILOBITA.

FAMILY **ILLÆNIDÆ**.

ILLÆNUS DANIELSI, n. sp.

Plate VII, Fig. 3, dorsal view of a magnesian limestone cast;
Fig. 4, anterior view of same specimen;
Fig. 5, pygidium of same,

Species, judging from our specimen, below medium size. Head short and much inrolled, length from the neck furrow to the anterior part, between the eyes, less than one-third the width. The head is abruptly bent inward from a line connecting the anterior part of the eyes. Glabella depressed convex, between the eyes, on top and re-curved in front. Dorsal furrows extend in almost parallel lines from the posterior part of the shield, to a shallow pit on the inner side of the anterior central part of each eye. Eyes large, distant, prominent and situated close to the posterior margin of the head. Palpebral lobe rounded. Facial suture extends from a point in the occipital furrow, behind the middle of the eye, inward to the posterior portion of the palpebral lobe, where it makes a rather sharp angle and then gently curves to the anterior part of the eye, then bends almost at right angles and then curves to the anterior margin, slightly within the line of the eye. Cheeks small, abruptly bent down and backward so as to extend, laterally, only a little beyond the outer lines of the eyes.

Thoracic segments ten, narrow; axis broad, depressed convex, full half the width of the animal, and a little wider at the anterior than at the posterior segment. On each side of the axis there is a flat space, about one-fourth the width of the lateral lobes, and then the pleuræ are bent gently backward.

Pygidium quite short, and, in outline, much like a double convex lens. It is not trilobate.

It is unnecessary to compare it with any other described species, for the purpose of distinguishing it.

Found in the Niagara Group, at Bonfield, near Kankakee, Illinois, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of L. E. Daniels, of Mazon, Illinois, an active collector, who discovered the species.

Famly **LICHIDÆ.**

LICHAS HANOVERENSIS, n. sp.

Plate VIII, Fig. 6, front view of head; Fig. 7, dorsal view *of head without cheeks.*

Glabella divided into three lobes by straight, longitudinal lines. The middle lobe is exceedingly high and quite evenly convex, from its posterior extension to the anterior border. It is like a cylinder bent in the form of two-thirds of a circle and covered with large and small tubercles. The lateral lobes are quite small and look like little auricles on the side of the central lobe. The anterior border of the head is in the form of a very small rounded rim, depressed at the lines dividing the glabella. A broad, rounded, transverse depression separates the central lobe of the glabella from the neck furrow, and upon each side, behind the lateral lobes of the glabella a transverse, elliptical swelling extends to the inner side of the visual organs. Movable cheeks not preserved.

This species resembles *L. palmata* or *L. scabra*, figured by Barrande, more than any of the described American species.

Found in the Niagara Group at Hanover, Indiana, and now in the collection of Wm. F. E. Gurley.

LICHAS BYRNESANUS, n. sp.

Plate VIII, Fig. 8, front view of head; Fig. 9, dorsal view of the head without the cheeks.

The glabella is covered with tubercles and divided into three lobes by slightly diverging lines on the dorsal side, but parallel lines in the front. The middle lobe is extended longitudinally into an obtuse point in front, far beyond the lateral lobes. The dorsal side is straight and convex longitudinally; the front is high, convex and very gently rounded, from the obtuse point, back to the anterior border. The lateral lobes are somewhat reniform, wider than the central lobe, but much shorter. The anterior border of the head is in the form of a very small rounded rim, depressed at the lines dividing the glabella into three lobes. There is a rather deep, transverse sulcus at the posterior part of the three lobes of the glabella, behind which, posterior to the central lobe, there is a flattened or slightly concave area in front of the neck furrow and behind the lateral lobes of the glabella, there is a transverse elevation produced into a conical elevation, laterally, beyond the lateral lobes and which extends to the visual organs. Movable cheeks not preserved.

Found in the Niagara Group a few miles back of Madison, Indiana, and now in the collection of S. A. Miller. The specific name is in remembrance of the late distinguished naturalist, Dr. R. M. Byrnes.

FAMILY CERAURIDÆ.

CERAURUS MILLERANUS, n. sp.

Plate VIII, Fig. 10, a fine specimen.

General outline of the entire body exclusive of spines subovate, but abruptly narrowed at the pygidium; surface tubercular. Head exclusive of the spines, subelliptical, width nearly three times as great as the length. Neck furrow strongly marked. Glabella gently convex dorsally, narrower at the base than the width of the cheeks, but at the anterior third about as wide as the posterior part of the cheeks; more convex in front and abruptly bent down to the margin. There are three short lateral furrows exclusive of the neck furrow, dorsal furrow sharp, lateral lobes convex; forehead lobe short. The eyes are placed about the center of the cheeks, but most distant from the dorsal furrow. They are small, prominent, globose and smooth, or minutely facetted. The facial sutures anterior to the eyes make a sigmoidal curve to the margin, in front of the eyes, and posteriorly they curve a little backward and cut the margin about even with the neck furrow continued, cheeks bear a short thick posterior spine.

Thorax has ten segments. Axis moderately convex and nearly as wide as the lateral lobes; a little wider at the anterior than at the posterior segment. The lateral lobes are flattened on each side of the dorsal furrow for one-third or one-half the width and then the pleuræ curve backward and taper to a point. A line of mammillary tubercles on each lateral lobe indicates the point at which the pleuræ commence to curve backward.

Pygidium very short and much narrower than the body and bearing two short thick spines, that curve toward each so that the points are closer than the bases.

This species is distinguished from *C. pleurexanthemus* by having proportionally a shorter head, shorter and thicker cheek spines, wider forehead lobe of the glabella, wider and less convex thoracic axis and shorter and thicker spines to the pygidium which curve toward each other instead of spreading. This species has been, generally, confounded with *C. pleurexanthemus*, but a comparison of numerous fragments as well as entire specimens has shown the above mentioned variations to be constant. It was first pointed out as a distinct species, from an examination of the specimen illustrated, about twenty years ago, by Dr. C. A. Miller, now deceased, in whose memory we now dedicate the species.

Found in the Hudson River Group, at Cincinnati, and now in the collection of Wm. F. E. Gurley.

PLATE I.

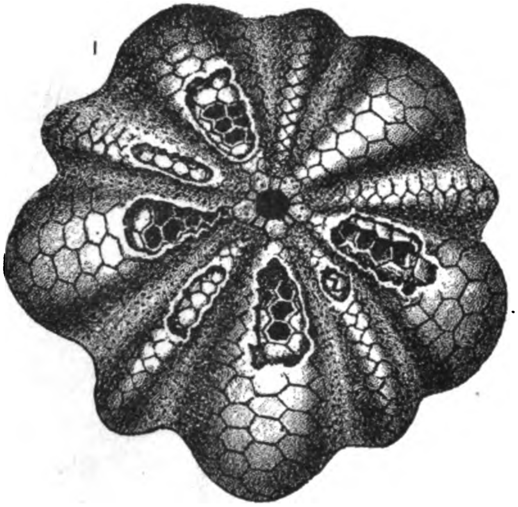
PAGE.

MELONITES INDIANENSIS, n. sp. 5
Fig. 1. Apical view.

OLIGOPORUS BLAIRI, n. sp. 6
Fig. 2. Upper part of a somewhat crushed example.
Fig. 6. A smaller specimen showing part of ambulacral pores.

OLIGOPORUS BELLULUS, n. sp. 7
Fig. 3. Part of the upper half of a crushed specimen.

OLIGOPORUS SULCATUS, n. sp. 8
Fig. 4. Basal view.
Fig. 5. Apical view.



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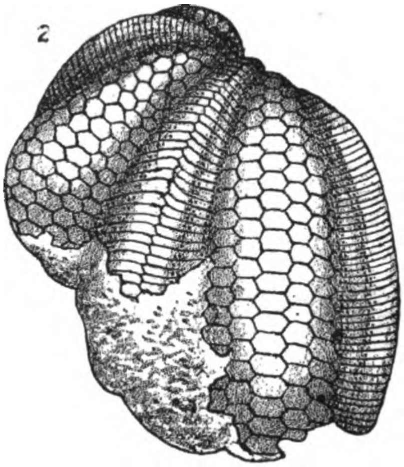

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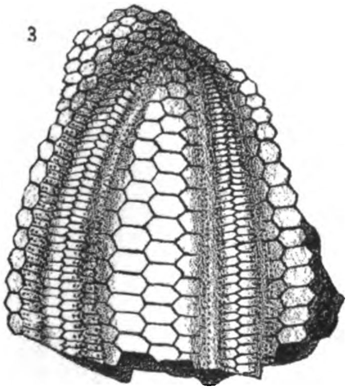

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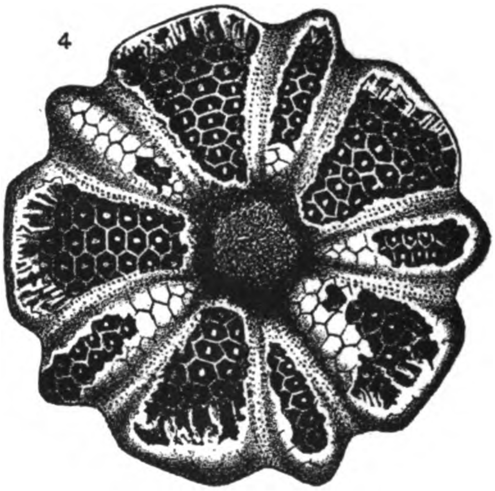

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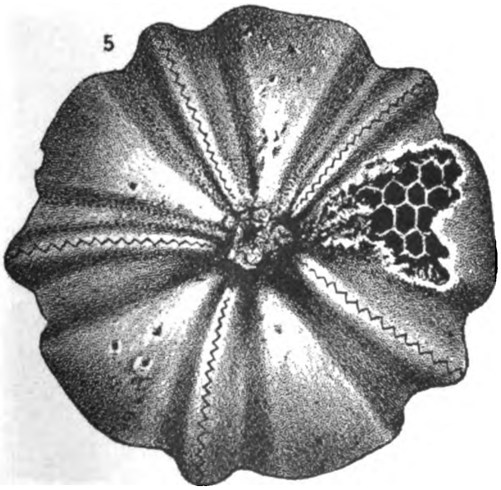

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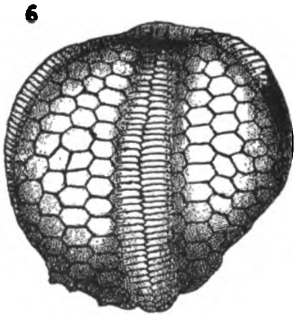

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H. HUNT, DEL.

PLATE II.

PAGE.

ACTINOCRINUS GIBSONI, n. sp. 10

Fig. 1. Dorsal, or opposite view from the azygous side.

ACTINOCRINUS ERRATICUS, n. sp. 14

Fig. 2. View opposite the azygous side.
Fig. 3. Azygous view.

ACTINOCRINUS ARROSUS, n. sp. 15

Fig. 4. Side view of a somewhat flattened calyx.

ACTINOCRINUS PLAGOSUS, n. sp. 16

Fig. 5. Azygous view of calyx.
Fig. 6. A crushed specimen showing the arms.

OLIGOPORUS BLAIRI, n. sp. 6

Fig. 7. The middle part of a rather large and flattened specimen.

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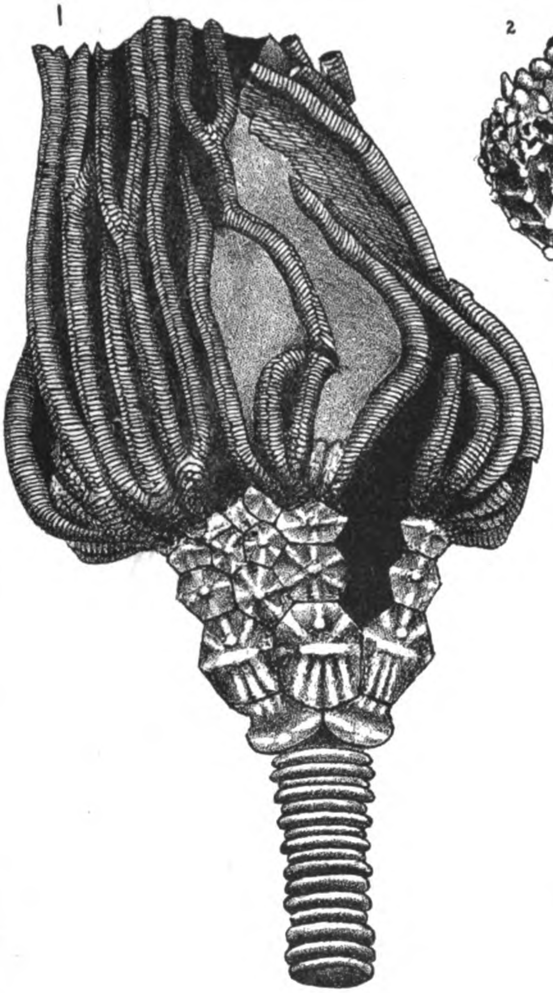

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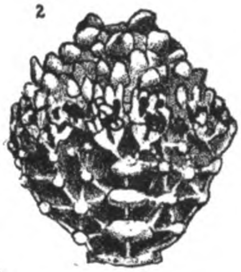

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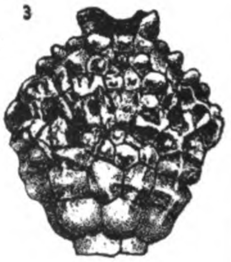

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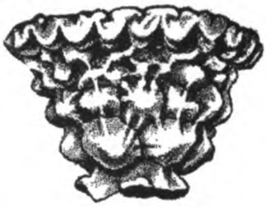

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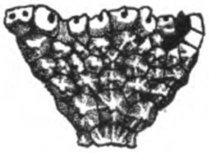

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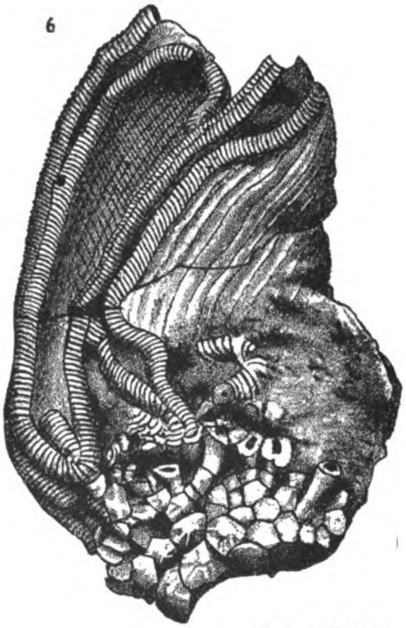

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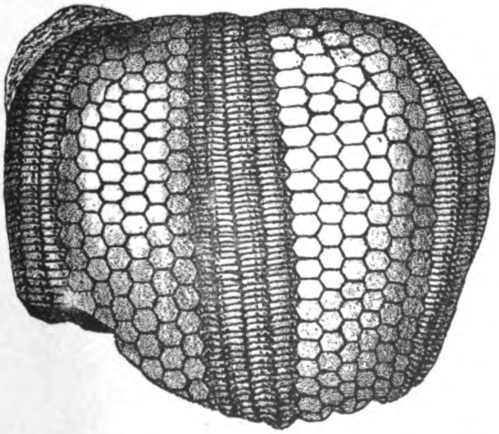

H. HUNT, DEL.

PLATE III.

PAGE.

ERETMOCRINUS LYONANUS, n. sp. 17
Fig. 1. Basal view of a specimen showing arms expanded on the surface of a rock.

CYATHOCRINUS ANDERSONI, n. sp. 30
Fig. 2. Symmetrical side.
Fig. 3. Azygous side.

BATOCRINUS LYONANUS, n. sp. 18
Fig. 4. View opposite the azygous side.
Fig. 5. Basal view.

BARYCRINUS FORMOSUS, n. sp 33
Fig. 6. Azygous view of calyx, arms and column.

CYATHOCRINUS TUMIDULUS, n. sp. 31
Fig. 7. View opposite the azygous side showing portion of arms.

ZEACRINUS BELLULUS, n. sp. 34
Fig. 8. View of calyx and arms, azygous side on the left.

TALAROCRINUS TRIJUGIS, n. sp. 45
Fig. 9. Basal view.
Fig. 10. Summit view.
Fig. 11. View opposite the azygous side.

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Bulletin No. 3. Plate III.

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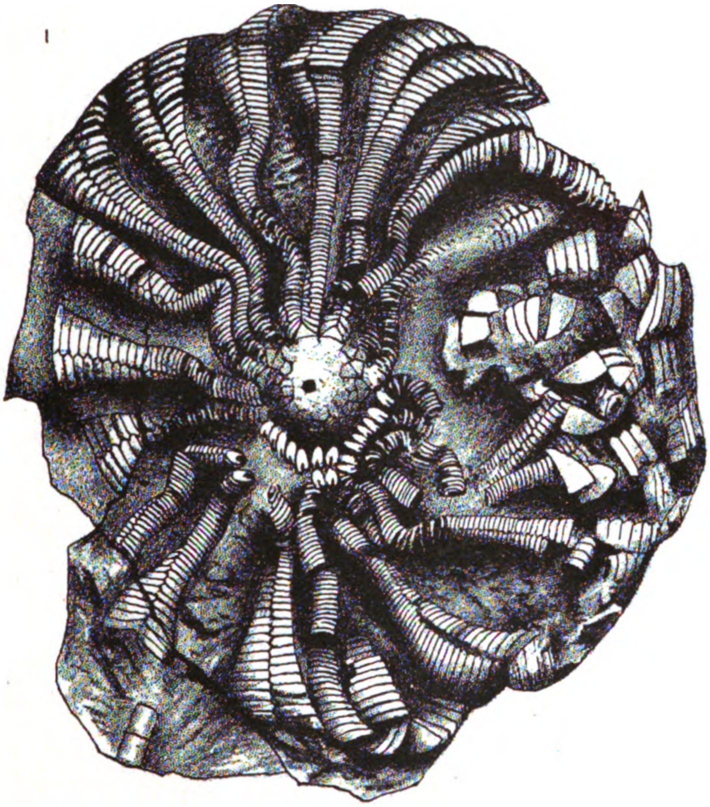

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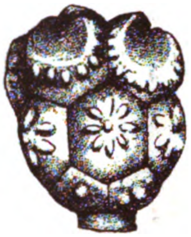

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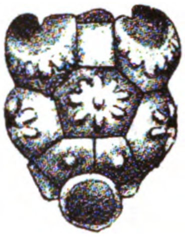

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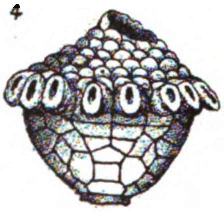

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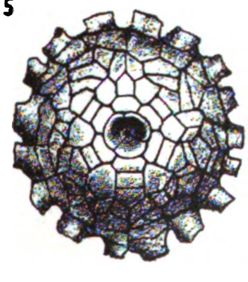

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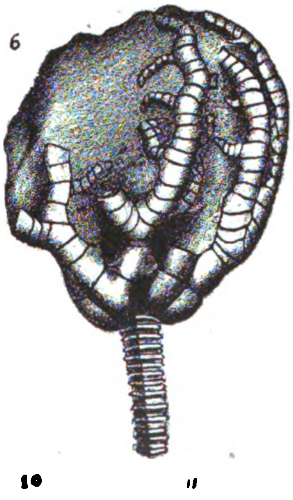

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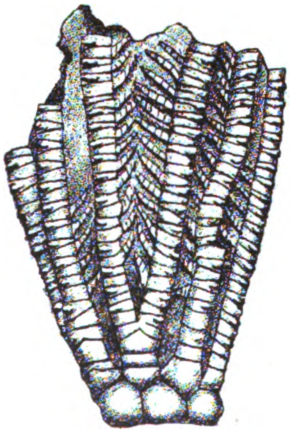

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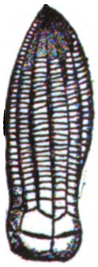

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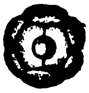

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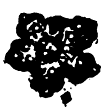

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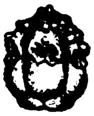

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H HUNT. DEL

PLATE IV.

PAGE.

FORBESOCRINUS PYRIFORMIS, n. sp. 47

Fig. 1. View of an almost entire specimen.

EUCALYPTOCRINUS WORTHENI, n. sp. 53

Fig. 2. Lateral view of calyx, arms and portion of the column.

TAXOCRINUS CRAWFORDSVILLENSIS, n. sp. 49

Fig. 3. Lateral view of calyx, arms and portion of the column.

GONIASTEROIDOCRINUS LYONANUS, n. sp. 55

Fig. 4. View of the vault and lateral prolongations.

ONYCHOCRINUS PARVUS, n. sp. 52

Fig. 5. Azygous side view of calyx, arms and portion of column.

ZEACRINUS OBESUS, n. sp. 35

Fig. 6 Side view showing the ray opposite the azygous area, on the right.
Fig. 7. Azygous view.
Fig. 8. Basal view.

SCAPHIOCRINUS MARTINENSIS, n. sp 38

Fig. 9. View showing calyx, part of the arms and part of the column.

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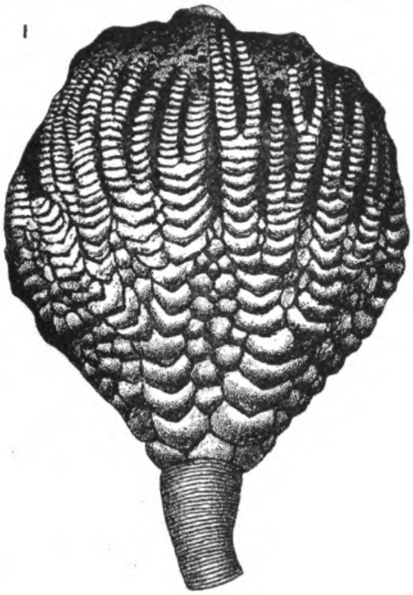

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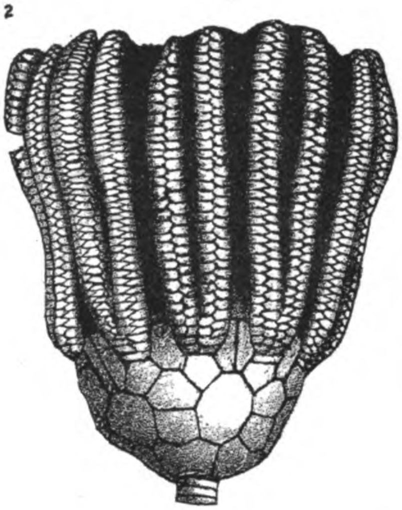

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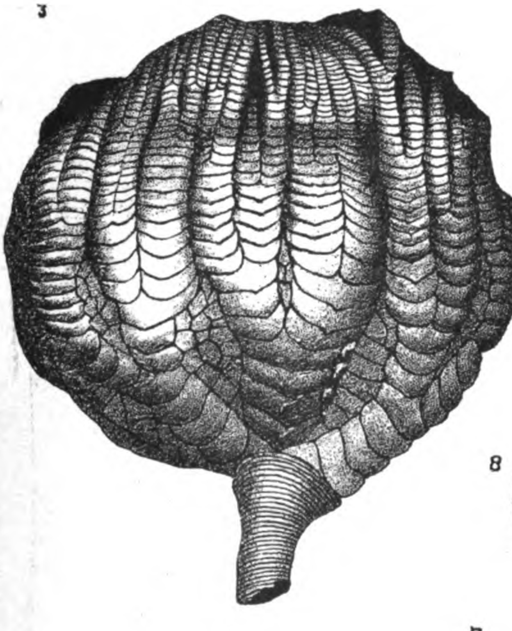

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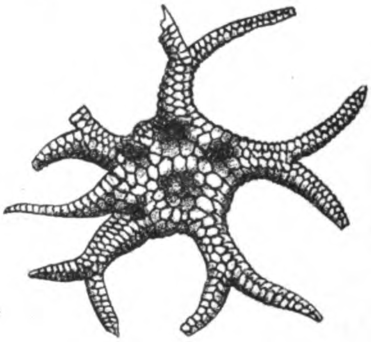

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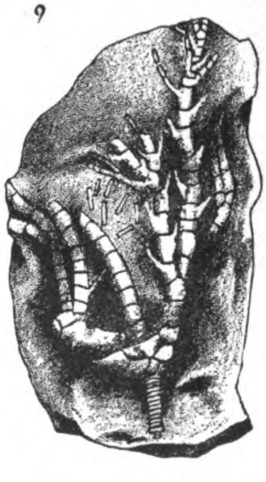

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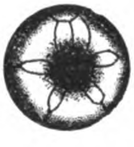

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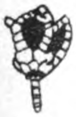

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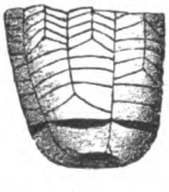

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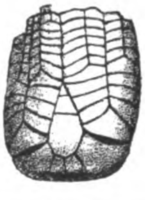

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PLATE V.

PAGE.

BATOCRINUS ALTIUSCULUS, n. sp. 20

Fig. 1. Side view, azygous area on the right.
Fig. 2. Azygous view.
Fig. 3. Summit view of same specimen, part of the top being broken away.

BATOCRINUS ASPRATILIS, n. sp 21

Fig. 4. Azygous view.
Fig. 5. Lateral view.
Fig. 6 Summit view.

BATOCRINUS SCYPHUS, n. sp 23

Fig. 7. Azygous view.
Fig. 8. Lateral view.
Fig. 9. Summit view.

BATOCRINUS LAETUS, n. sp 24

Fig. 10. View opposite the azygous area.
Fig. 11. View of azygous side.
Fig. 12. View of summit of same specimen.

BATOCRINUS ÆQUABILIS, n. sp 25

Fig. 13. Azygous view.
Fig. 14. View of opposite side.
Fig. 15. Summit of same specimen.

ULOCRINUS BLAIRI, n. sp 57

Fig. 16. View of azygous side.
Fig. 17. Basal view.
Fig. 18. View opposite the azygous side.

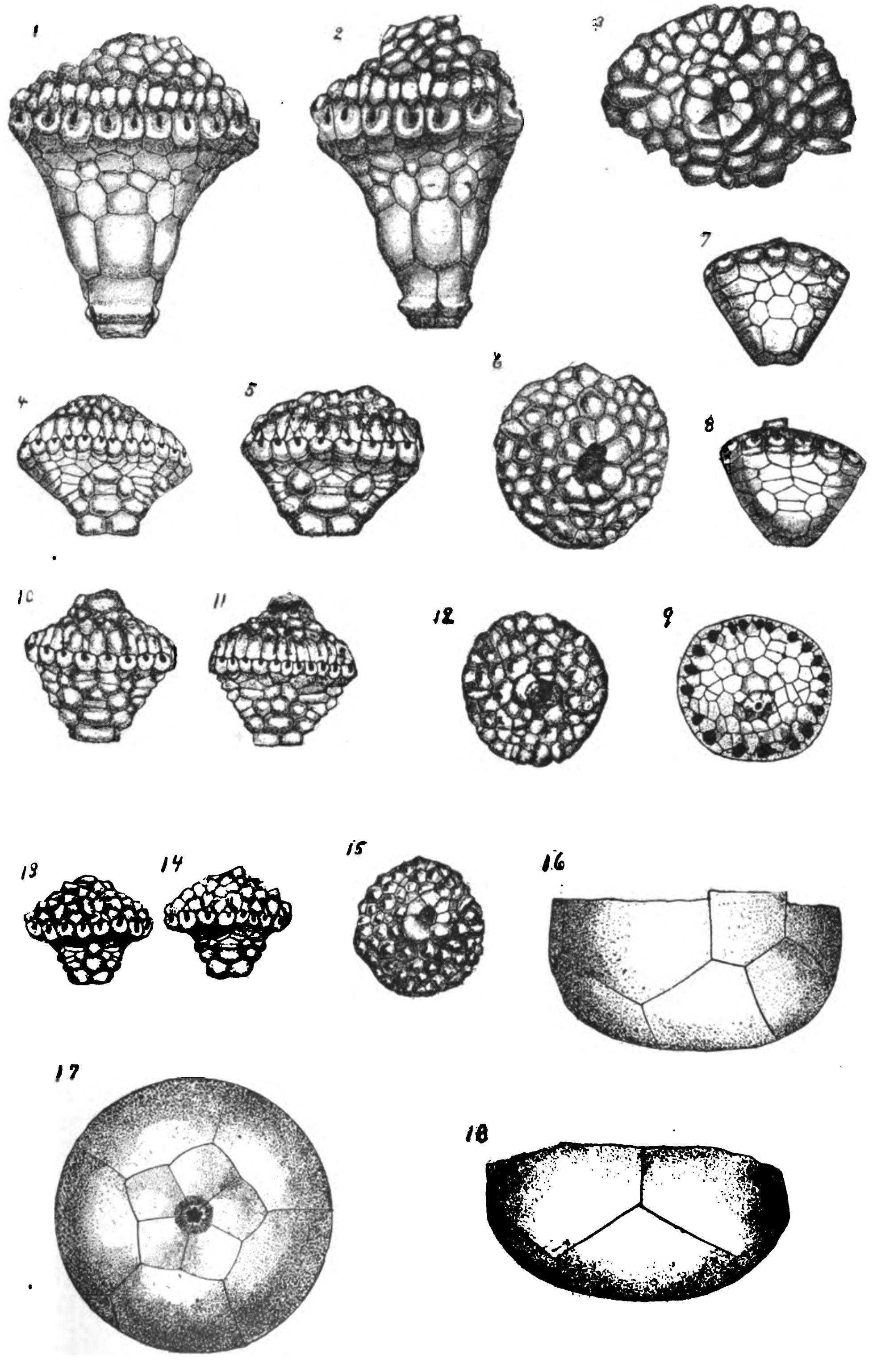

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PLATE VI.

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STROTOCRINUS VENUSTUS, n. sp. 26
Fig. 1. Side and basal view of the calyx.

HYDREIONOCRINUS SANCTILUDOVICI, Worthen 40
Fig. 2. View of the type specimen.

ZEACRINUS NITIDUS, n. sp. 36
Fig. 3. Azygous view.
Fig. 4. View opposite azygous side.

SCAPHIOCRINUS AEROSUS, n. sp. 39
Fig. 5. View of azygous side of calyx and arms.

ULOCRINUS OCCIDENTALIS, n. sp. 58
Fig. 6. View of the basal plates, part of two being broken away.
Fig. 7. Interior view of the same specimen.
Fig. 8. A subradial plate.

AESIOCRINUS ANGULATUS, n. sp. 59
Fig. 9. View of calyx, part of an arm, and three azygous plates. The specimen is somewhat depressed.

CYATHOCRINUS SIGNATUS, n. sp. 32
Fig. 10. Side view of calyx and part of the arms.

HYDREIONOCRINUS SUBSINUATUS, n. sp. 40
Fig. 11. Azygous view of calyx.
Fig. 12. Basal view of the same specimen.
Fig. 13. Azygous side view of another specimen preserving part of the spinous second radials.
Fig. 14. Basal view of the same specimen.

HYDREIONOCRINUS NODULIFERUS, n. sp. 41
Fig. 15. View opposite the azygous area.
Fig. 16. Azygous view.
Fig. 17. Basal view of the same specimen showing the protruding part of the second radials.

HYDREIONOCRINUS CRASSIDISCUS, n. sp. 43
Fig. 18. Basal view.
Fig. 19. Azygous side of calyx.

HYDREIONOCRINUS GRANULIFERUS, n. sp. 44
Fig. 20. Azygous side view of calyx and one second radial.
Fig. 21. Basal view of the same specimen.

EUPACHYCRINUS PARVUS, n. sp. 60
Fig. 22. Basal view.
Fig. 23. Azygous side view.

NUCLEOCRINUS GREENEI, n. sp. 62
Fig. 24. Side view.
Fig. 25. Basal view.

NUCLEOCRINUS VENUSTUS, n. sp. 63
Figs. 26, 28 and 30. Side views.
Fig. 27. Summit view.
Fig. 29. Basal view.

GRANATOCRINUS SPHÆROIDALIS, n. sp. 65
Fig. 31. Summit view.
Fig. 32. Basal view.
Fig. 33. Lateral view—(The artist has overlooked the interradial sutures).

GRANATOCRINUS WINSLOWI, n. sp. 66
Fig. 34. Side view.
Fig. 35. Basal view.

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Bulletin No. 3. **Plate VI.**

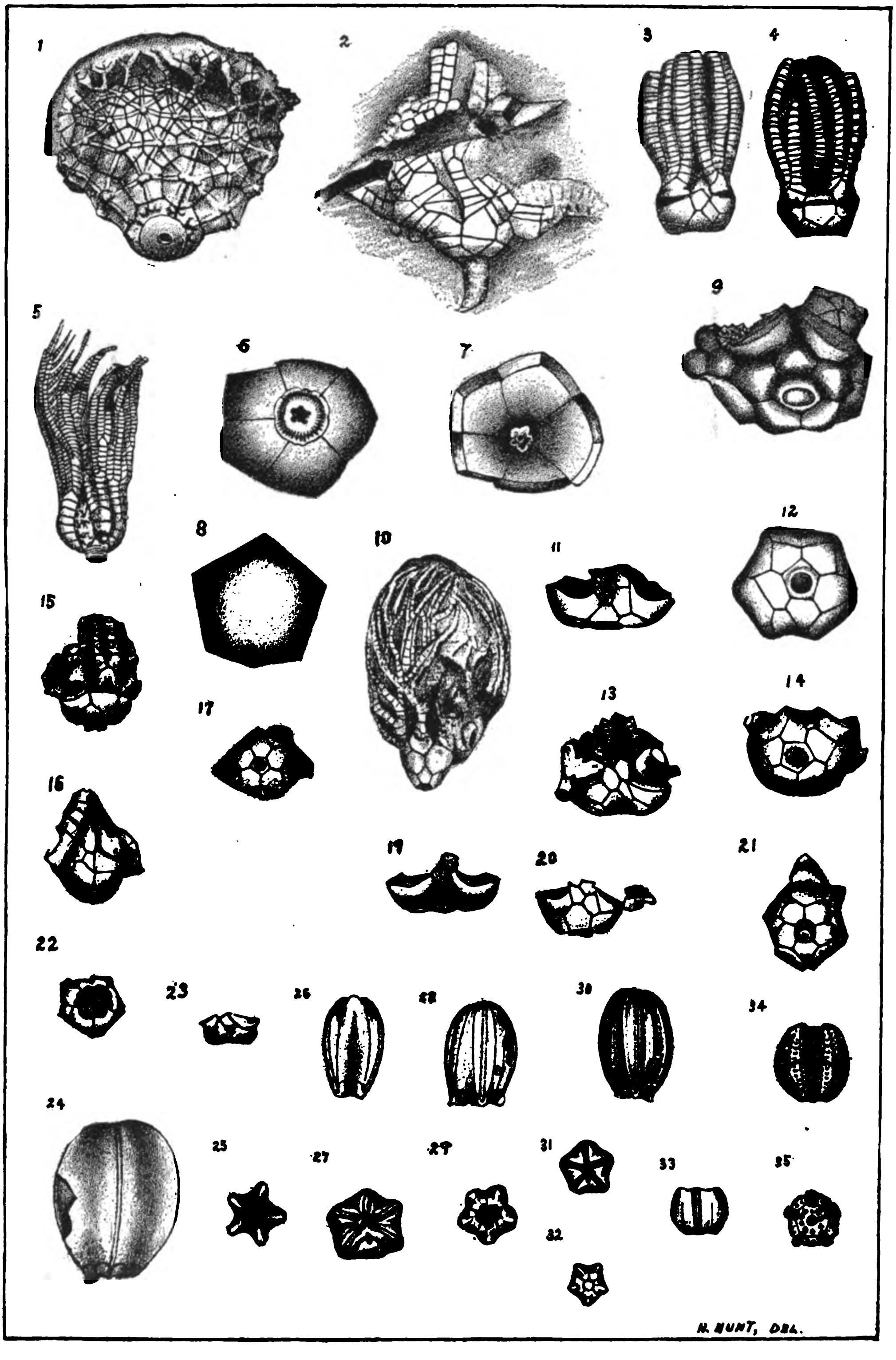

PLATE VII.

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Lingula indianensis, n. sp 69

Fig. 1. Ventral valve.

Discina illinoisensis, n. sp.. 70

Fig. 2. Dorsal view.
Fig. 3. Interior of ventral valve.
Fig. 4. Dorsal valve of another specimen.
Fig. 5. Interior of a dorsal valve of another specimen.

Discina munda, n. sp.. 71

Fig. 6. Dorsal view.
Fig. 7. Lateral view of the same valve.

Eatonia coulteri, n. sp 72

Fig. 8. Ventral view.
Fig. 9. Dorsal view.
Fig. 10. Cardinal view.
Fig. 11. Front view.

Michilinia branneri, n. sp 68

Fig. 12. Side view.
Fig. 13. Summit view.

Conularia blairi, n. sp 73

Fig. 14. Portion of surface of upper part of shell.
Fig. 15. A specimen showing a portion of the inside of a shell.

Blairocrinus spinosulus, n. sp.. 28

Fig. 16. Azygous view.
Fig. 17. Opposite view of same specimen.
Fig. 18. Summit view.

Campophyllum kansasensis, n. sp.. 67

Fig's. 19 and 20. Calyces.
Fig's. 21 and 22. Lateral views of same specimens.

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Bulletin No. 3.

Plate VII.

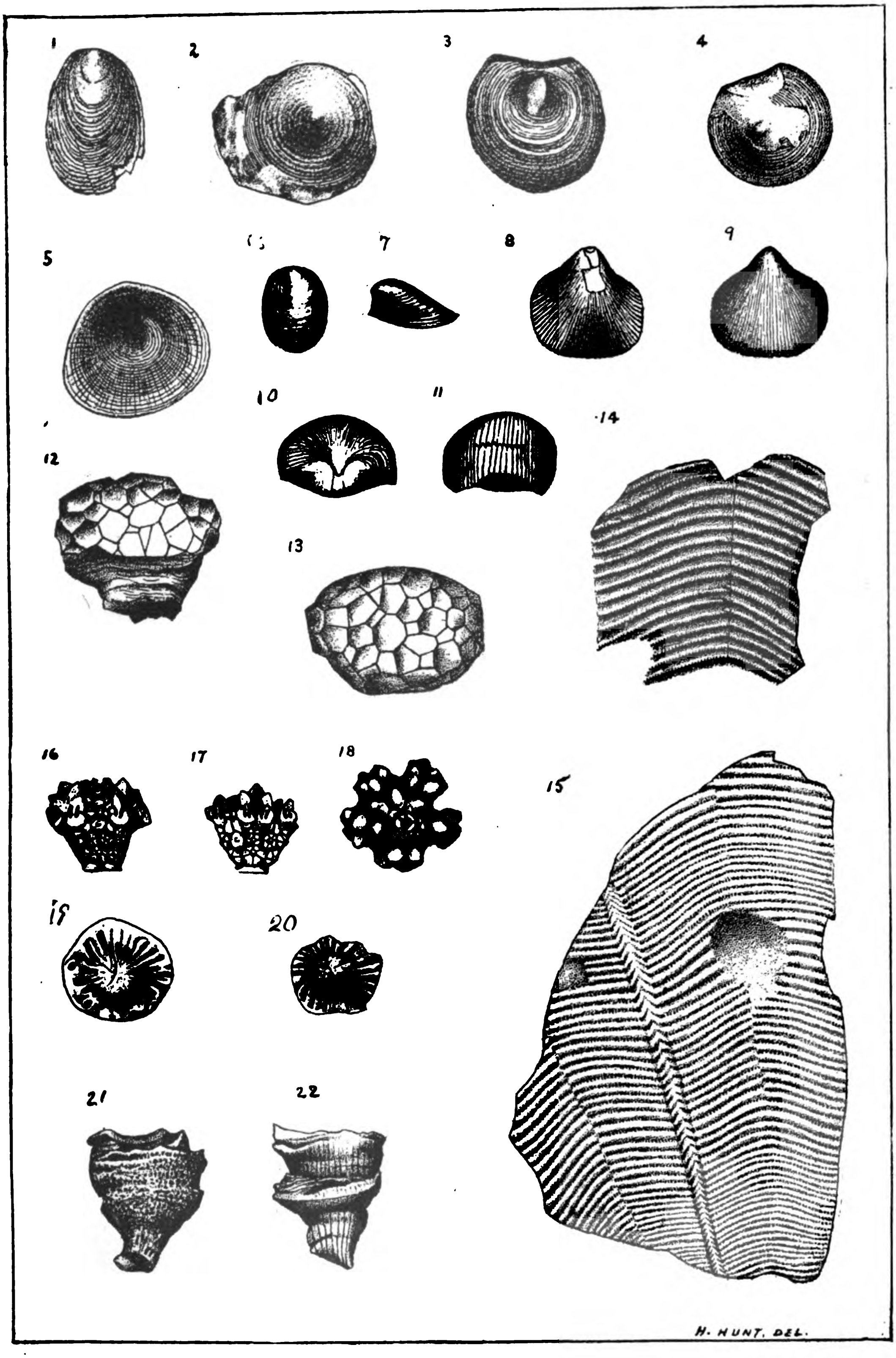

PLATE VIII.

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CONULARIA GRATIOSA, n. sp. 74
Fig. 1. Showing two sides of a slightly compressed specimen.

CONULARIA SPERGENENSIS, n. sp. 74
Fig. 2. View of a specimen with both ends destroyed.

ILLÆNUS DANIELSI 76
Fig. 3. Dorsal view of cast.
Fig. 4. Anterior view of same specimen.
Fig. 5. Pygidium of same.

LICHAS HANOVERENSIS, n. sp. 78
Fig. 6. Front view of head.
Fig. 7. Dorsal view of head without cheeks.

LICHAS BYRNESANUS, n. sp. 78
Fig. 8. Front view of head.
Fig. 9. Dorsal view of head without cheeks.

CERAURUS MILLERANUS, n. sp. 80
Fig. 10. Dorsal view of a very fine specimen.

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Bulletin No. 3. Plate VIII.

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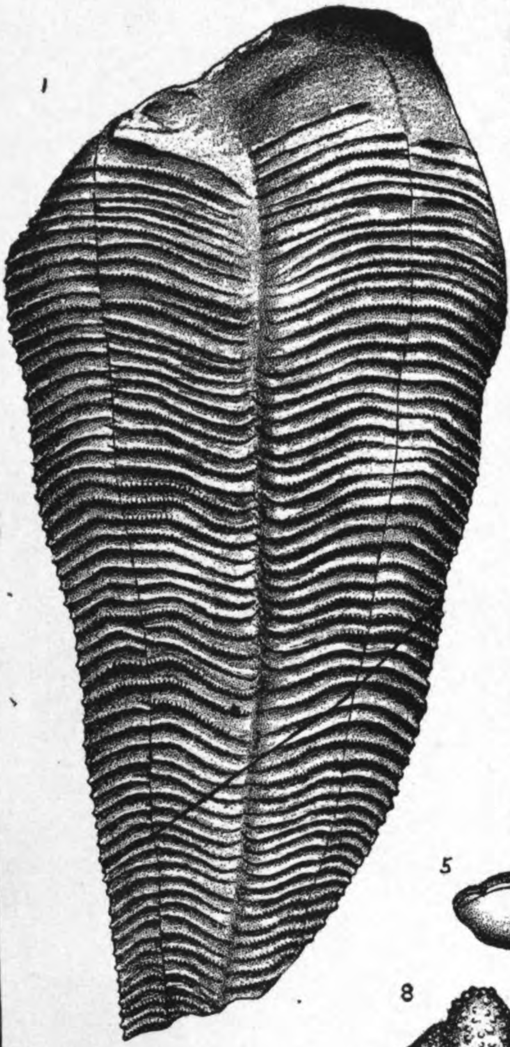

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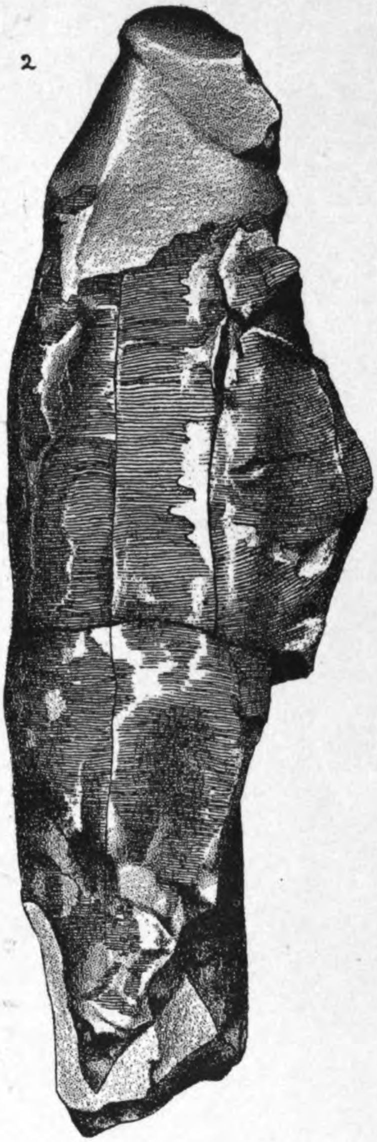

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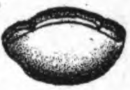

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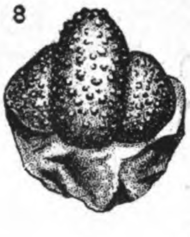

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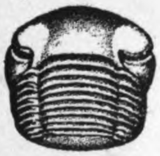

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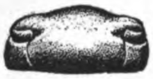

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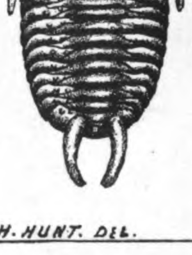

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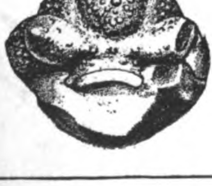

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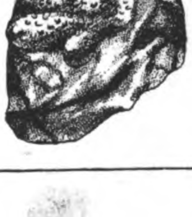

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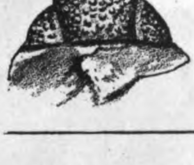

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BULLETIN NO. 4

OF THE

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OF

NATURAL HISTORY.

UPPER DEVONIAN AND NIAGARA CRINOIDS.

3 plates

BY S. A. MILLER AND WM. F. E. GURLEY.

SPRINGFIELD, ILLINOIS,
October 15, 1894.

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With Compliments of

PROF. WM. F. E. GURLEY,
STATE GEOLOGIST,

SPRINGFIELD, ILLINOIS, U. S. A.

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SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA.

FAMILY MELOCRINIDÆ.

DOLATOCRINUS MAGNIFICUS, n. sp.

Plate 1, Fig. 1, basal view of the calyx, injured in the middle part; Fig. 2, view of the vault, part of which is broken away and the sutures between the plates only partly preserved; Fig. 3, lateral view, with the six-armed ray in front and showing height of vault.

Calyx very large sub-hemispheroidal, broadly lobed in the radial fields and slightly concave below. The radial field opposite the azygous side is much larger, more prominent and more broadly lobed than either of the others. The diameter of the specimen illustrated is two and six-tenths inches and height one and two-tenths inches. The dome is only moderately convex, the radial areas being raised and the interradial areas depressed. Surface of the plates of the calyx sculptured, the larger ones bearing a central node. The radiating ridges do not connect from one plate to another, as is usual in the ornamentation of crinoids, but a radiating ridge may be directed toward the suture between two adjoining plates, instead of joining an end to that of a similar ridge on a contiguous plate; and there are shorter and longer ridges and nodes on the plates. The plates of a kind, however, are ornamented alike and on the whole the ornamentation is very pleasing.

The column, in our specimen, is broken off by an irregular fracture and part of the radial plates are injured. Enough is preserved, however, to show that the column is very large and conceals the basal plates that are deeply sunken in the interior of the calyx. The columnar canal is slightly pentalobate.

Basal plates concealed in the calyx. First primary radials probably as long as wide, including the projection up into the calyx to reach the basal plates, but one-half wider than high as exposed around the columnar cavity. The superior side of each is quite concave, and the inferior end is abruptly sunk in the basal cavity, so as to form a funnel around the upper end of the column, as we have seen in specimens of *D. marshi* and other species in this genus, but the depth of the funnel we have not observed in this species.

Second primary radials quadrangular, one-third wider than high, both the inferior and superior sides somewhat convex, and each bears a rather large central tubercle. The superior sides of these plates curve slightly upward and the inferior sides bend a little toward the basal depression, so that the calyx may be made to rest on the central tubercles of these plates.

Third primary radials, in four of the rays, pentagonal, larger than the second radials and about one-fourth wider than long. We will follow these four rays to the arms and afterward recur to the other ray. On each of the upper sloping sides of these four third primary radials there is a single, large, hexagonal, secondary radial, which supports on each of its superior sides two tertiary radials, the last of which supports the free arms. This gives us four arms to each of these four radial series.

In the other or fifth ray, which is opposite the azygous area, the third primary radial is broadly truncated above, hexagonal, twice as wide as high, and supports, upon its upper face, a series of three intersecondary and intertertiary plates, and upon each of its superior lateral sides a single large secondary radial, one of which is hexagonal and the other heptagonal. Each secondary radial bears upon its inner superior sloping side a series of three tertiary radials, the last one of which bears a free arm, and upon its outer superior sloping side a single, large, tertiary radial, which, in turn, supports upon each of its two upper sloping sides two radials of the fourth or quarternary series, the last of which support free arms. This structure gives to this ray six arms. The first intersecondary radial in this series is a large, quadrangular plate, having nearly equal sides; it is followed by an hexagonal plate abutting its two undersloping sides upon the secondary radials and two upper sloping sides upon the tertiary radials and supporting upon the upper truncated face a somewhat smaller pentagonal plate, that abuts its superior sloping sides against the adjacent tertiary radials, that support the free arms. The six plates that support the six free arms in this radial series abut against each other without any intervening plates.

There are, as shown above, twenty-two arms, in this species, which are more than have been found in any species heretofore described. If, however, the ray containing six arms and three interradial plates is abnormal the species would have twenty arms and still be so different from any species heretofore described that no comparison with any of them would serve any purpose in distinguishing it. There is nothing to indicate that this six-armed radial series may be abnormal and we believe it is in the normal condition of the species.

The first interradials are the larger plates of the calyx as exposed on the surface, and larger, in fact, than any of the other plates, unless the first primary radials, including that part which forms the funnel in the columnar cavity should prove to have as great or greater size. The one opposite the six-armed series or first azygous interradial is the larger one and has eleven sides; an approximate one is the smaller and has nine sides; the other three have ten sides each. The first interradial is followed by a single plate that extends nearly to the top of the calyx, and which, in turn, is followed by one or two small plates that separate the arms and connect with the plates of the vault, except in the azygous area, where three plates separate the arms and connect with the plates of the vault. The sutures between the plates in the upper part of some of the interradial areas are not distinct in our specimen, and for that reason are not shown in the illustration.

The dome or vault, as may be seen in the illustration, has part of the plates broken away on the azygous side and some of the sutures are anchylosed or obscure. It is, however, covered with large, polygonal plates of very unequal size. It is most convex toward the six-armed series opposite the azygous side and most sinuate or depressed at the azygous interradius. No pores or passages through the vault between the arms have been found in our specimen.

The specimen from which the foregoing description is drawn is the largest known Dolatocrinus. It was found in the Hamilton Group, at the Falls of the Ohio, and is now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS SPINOSUS n. sp.

Plate I, Fig. 4, basal view of the calyx, without the surface markings of the plates; Fig. 5, lateral view, showing some of the spines on the plates of the vault.

Calyx large, subhemispheroidal, broadly lobed in the radial fields, and depressed concave on the lower side. Apparently no azygous interradius. The diameter of the specimen illustrated is two and two-tenths inches, and height three-fourths of an inch, though we have seen specimens only about two-thirds as large. Vault moderately convex and slightly depressed in the interradial areas. A strong ridge crosses the primary radials. Column round and deeply inserted in the calyx. Surface ornamentation not preserved in any of our specimens.

Basal plates sunk deep within the calyx and extending internally as high as the arm openings. First primary radials twice as wide as high externally, but near the middle of the plates they are abruptly bent, almost at right angles, into the basal cavity, where they form a funnel to the basal plates, into which the column is inserted, so that, in fact, their length is fully equal to their greatest width. The superior face is slightly concave.

Second primary radials quadrangular and more than one-half wider than high. Third primary radials slightly larger than the second, pentagonal, a little wider than high, and supporting upon each upper sloping side a single secondary radial.

Secondary radials nearly as large as the third primary radials pentagonal, and supporting upon each upper sloping side a series of three tertiary radials, the last one of which bears the free arms. The first tertiary radials are larger than the second or third. The species bears twenty arms.

The first interradials, in each area, are elongated eleven sided plates and larger than any of the other plates in the body. Each one is followed by an hexagonal plate that is as long or longer than wide and supports three narrow, elongated plates in the third range that reach as high as the base of the arms. These are followed, in the fourth range, by three plates that separate the arms, and unite with the plates of the vault. One or two intersecondary plates (apparently a pair of them) are inserted at the base of the arms in the intersecondary areas, but it is not clear, in our specimens, that they unite with the plates of the vault. Probably they do not, but as the sutures are destroyed this cannot be determined.

The limestone matrix covers the greater part of the vault, in our best specimen, so that but little can be said of it beyond what is shown by the illustration. It is characterized, however, by a plate over each double radial series which bears a very long, strong spine. The broken ends of spines belonging to other plates are preserved in the matrix, but there is no evidence of a proboscis. The summit of the vault is apparently below the top of the matrix shown in the illustration, and not as high as the top of the spines over the radial series.

There have been described, heretofore, only two species bearing twenty arms—*D. lamellosus* and *D. troosti*—and this species is so far removed from them that comparison is unnecessary.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS LACUS, Lyon.

Plate I, Fig. 6, side view; Fig. 7, basal view.

Lyon described the body as "subglobose, truncated below, columnar pit broad and deep; summit somewhat conical, prolonged by a proboscis: column round, columnar perforation rather large and pentalobate." He said; "The body is adorned by a most beautiful network of raised triangular figures; the points of the principal triangular figures rise from, and terminate at the center of the first interradial pieces; a subordinate set of figures terminate at the center of all the pieces below the arms. In some specimens the lines are continuous, in others, interrupted. The summit pieces are sometimes adorned by a single prominent granule; in other specimens, many of the pieces are ornamented by a number of granules, arranged in lines across some of the pieces in nearly parallel rows, or in a circular band around a more prominent central one."

Our specimens agree with the above description and in comparison with other species we would note the high calyx, with a slight constriction below the arm bases, the flattened or truncated base, and pentagonal, funnel shaped, columnar pit, bounded externally by a raised ridge running from a central tubercle on each first radial to another, so as to bound the columnar cavity with a raised pentagonal figure. We have illustrated a basal view to show this pentagonal outline, because Lyon's figure does not show its pentagonal character.

The basal plates are deeply sunken. First primary radials including the extension into the columnar cavity longer than wide; ornamented with sculptured ridges, which terminate at a central node, at each angle of the columnar depression. Second radials quandrangular, wider than high, and bearing a central node. Third radials pentagonal, wider than high, and bearing a central node. First secondary radials as large or larger than the third primary radials. Second secondary radials much smaller and of irregular form and size. Third secondary radials still smaller and of irregular form and size. Arms, ten, composed of ovoid flat pieces of equal thickness.

First interradials the larger plates of the calyx, nine-sided, subovate, angularly pointed below and resting between the upper sloping sides of the first primary radials, the upper sloping sides separate the first secondary radials and the superior side is truncated for a single plate in the second range. Second interradials subquadrate, four pentagonal and one quandrangular and followed by two small plates in the third range (in some areas there are three) and these by three smaller, elongated plates (sometimes there are only two) that separate the arms and unite with the plates of the vault. Intersecondary plates, two, similar to the last three in the interradial areas, and separating the arm bases and uniting with the plates of the vault. Above the summit of the three intersecondary plates and also above the summit of the last two or three interradials, two elongated pores or passages penetrate the vault horizontally. In some interradial areas there are four of these pores, especially where there are three plates in the third range. These pores are conspicuous, in our specimens, but they seem to have been entirely overlooked by Lyon, for they are not shown in his illustration or mentioned in his text. We have given a side view of a specimen for the purpose of showing the interradials and intersecondary plates and the pores, because Lyon's illustration is very erroneous and defective, in all these respects.

Found in the Upper Helderberg Group, at the Falls of the Ohio, and in Clark County, Indiana.

DOLATOCRINUS MARSHI, Lyon.

Plate 1, Fig. 8, showing the abrupt bending of the first radials into a pentagonal funnel shaped cavity.

This species was described and illustrated, by Lyon, in 1869, in the Transactions of the American Philosophical Society, vol. XIII, p. 461, pl. XXVII, Figs. *n*, *n1 and n2.* His description and illustrations are very good, and for the purpose of identifying the species none other are necessary, but that publication is rare and but few western people ever have an opportunity to see it, and, for that reason alone, we are justified in redescribing it. But our principal object, in calling attention to it, is for the purpose of redescribing and showing a basal view, as we have a specimen hollow on the inside and showing both the exterior and interior of all the plates.

Lyon described the calyx as "discoid, with five broad, sharp carina, which rise perpendicularly from the margin of the basal pit, and extend outward, equally elevated to the center of the third radials, the carina rising gradually from the margins of the radials, then more rapidly to the center of the pieces. At the center of the third radials the carina sends out branches, not quite so bold as the main stem, but strong, involving all the pieces of the superradials up to the arm bases. Arm bases prominent, in groups of two to each ray, producing a lobed, pentagonal figure of that section of the body. The dome is subconical; twice as high as the body below the arms; surmounted by a thick, strong, subcentral proboscis. The interradial fields unite to the dome-covering between the arms."

The characters above described, to which special attention may be directed, are the low calyx, high vault, subcentral proboscis and carina. Instead of ordinary radial ridges occupying the central part of the radial plates, the whole plates are involved in forming a high central ridge, in each series, which Lyon calls the "carina." And they "rise perpendicularly from the margin of the basal point," which is a striking peculiarity, much more noticeable in a specimen than it is in his illustration or in ours, though the attention of the artist was called specially to it, and our figure is accurate except in giving a full idea of the height of the "carina" at the "basal pit." The surface of the plates is covered with fine ridges, disposed in groups, radiating from the center of the plates.

The basal plates form a cone, the top of which is on a level with the top of the calyx. The internal position which they occupied, probably caused them to become anchylosed, at all events, one cannot see any possible flexibility they could give the animal, in that situation, if they were not anchylosed. The summit of these anchylosed plates is perforated with a large pentalobate or cinque-foil columnar canal. There is a rim, formed by a thickening of the plates, within the apical part of the cone to which the end of the column was attached, and it appears that the column filled the interior of the cone and the plates were more or less attached to it.

The first primary radials form a pentagonal funnel that extends to the base of the cone formed by the basal plates. The length of the funnel, without including the height of the carina, is equal to the greatest width of the radials. In other words, the length of the first radials is more than their greatest width, but the plates are abruptly bent, and four-fifths of the length is within the funnel shaped basal cavity, and only one-fifth without, which is very little more than the thickness of a plate. It seems quite impossible to show the true depth of the funnel, by pen drawing, but the artist has indicated it as well as he could, in the illustration, which is a character not attempted to be shown, in Lyon's figure of the base of the calyx of this species. In the inside of the calyx, neither the pentagonal form of the funnel nor the external carina are indicated, but a round cone is formed by the extension into the interior of the first radials and basal plates.

Second primary radials quadrangular one-half wider than long. Third primary radials wider than the second and wider than long, pentagonal, and support on each upper sloping side three or four secondary radials, the last of which supports the free arms. The radial series are of variable length within the calyx, as mentioned by Lyon, which somewhat destroys the symmetry of the calyx. There are ten arms.

There are from seven to nine interradials in each area. The first is large, subovoid and has nine sides, it supports a hexagonal plate as large as a primary radial, and it is followed by three plates, in the third range, except in one area, where there are only two. There are two plates in the fourth range, except in one area, where there are four, and two in the fifth range, to which are united the points of the long pieces that lie between the lobes on the dome, according to Lyon. Some specimens, however, we think show more than two plates, in the last range, in some of the areas.

There are from two to four intersecondary plates in each area wedged between the arm bases; when four, they are in pairs, one above the other.

"The dome is covered by large pieces; each field between the lobes contains a pair of the largest, which reach from the arm-bases toward the proboscis; they are six or seven sided; long; broadest at the upper extremity; pointed, or very slightly truncated at the lower end; joining each other by their longest sides, at the center of the depression between the lobes. A circle of large pieces surround the dome; all of these rest partly upon the ten long pieces. The pieces composing this zone are of different sizes; they also differ in form; all six sided; two of the largest pieces of the circle rest directly over two of the long pieces; three other groups of the long pieces unite under the suture, uniting two of the pieces forming the circle, so that the sutures, uniting both sets of pieces, form one line from the arm bases to the base of the second circle surrounding the dome near the base of the proboscis. Below the zone described, and between the groups of long pieces, are groups of from five to seven pieces, the upper one of which is joined to the circle above the group of long pieces, and on which it rests. The lowest piece of these groups is lanceolate; is lodged between the arm bases, and unites with the interbrachials. The upper and largest piece of these several groups is of the same size and form as the pieces comprising the first zone around the top of the dome. Around the arm bases the pieces are numerous and quite small. The pieces comprising the lower zone, and the large ones of the groups above the arms, are surmounted by a group of from three to five rough, pointed spines, confluent near their bases. The plates of the second zone at the base of the proboscis are ornamented with hemispherical tubercles, all other pieces of the dome are gibbous or concave and not ornamented."

In this species there are from four to six pores between each of the arm bases, that were not mentioned by Lyon, or shown in his illustrations, and which are quite conspicuous in our specimens. These pores or passages are elongated. They commence by a slight horizontal furrow across the top of the last interradial plates in the calyx and penetrate the adjoining plates of the vault horizontally, which makes an elongated surface opening. This feature is present and even more noticeable in *Dolatocrinus grandis* and may be understood by referring to the illustration of that species. We know all these openings penetrate the test because we can see through them.

This species occurs in the Upper Helderburg Group, at the Falls of the Ohio, and in Clark county, Indiana.

DOLATOCRINUS GRANDIS, n. sp.

Plate II, Fig. 1, basal view of the calyx; Fig. 2, view of the vault broken in the central part; Fig. 3, lateral view.

Calyx very large, subhemispheroidal, quite concave below, the concavity including part of the third primary plates, and most depressed in the interradial areas. The diameter of the specimen illustrated is two and three-tenths inches; height to the place where the vault is broken, one and fifty-five hundredths inches; height of calyx, nine-tenths of an inch; height of vault, if unbroken, and calyx about equal. The vault is quite convex, a little more abrupt on one side than the other, indicating that it possessed a proboscis on the abrupt side, and it is very slightly depressed in the interradial areas. Surface of the calyx beautifully and delicately sculptured, numerous raised lines seem to cross the sutures from one plate to another, but none of them arise from nodes or tubercles. The sutures are not beveled and in some parts they are very indistinct. The sutures on the vault are distinct and beveled and between the larger plates they are broadly and deeply grooved, the grooves being bounded with a rim of granules, while the central part of each plate is concave or sculptured and sometimes granulous. The columnar cavity and part of the first primary radials, in our specimen, are covered with the limestone matrix.

First primary radials very little wider than high, upper side transverse. Second primary radials quadrangular and about one-fourth wider than high. Third primary radials larger than the second, pentagonal, and from one-fourth to one-third wider than high. The superior sides bend upward and the inferior sides curve into the basal depression so that the calyx can be made to rest on a smooth surface on the third radials. Each one supports on each upper sloping side a series of secondary radials the last ones of which support the free arms.

The first secondary radials are fully as large or larger than the third primary radials, rather wider than high, part of them pentagonal and the others hexagonal, and each one abuts upon the first interradial and one of the plates in the second range of interradials. The second secondary radials are as large as the first and wider than high, but not of uniform size. The third secondary radials seem to be smaller than the second, but the sutures are anchylosed, or so obscure, in our specimen, that the outlines cannot be accurately determined. Above these the arm bases become prominent. There are only ten arms in this species, but they are very large and composed of a double series of interlocking plates.

The interradial areas are not exactly of uniform size nor is it certain that they are filled with the same number of plates. The first interradials are the larger plates in the calyx. Each one has ten sides, is much elongated, rests its lower angle between the two upper sloping sides of two first primary radials, and separates the first secondary radials between its upper lateral sides, and supports upon the two superior faces two rather large and more or less elongated plates in the second range. In some areas these plates are larger than in other areas. In three of the areas, where the sutures are distinct, there are two plates, in the third range, about half the size of those in the second range, four small plates in the fourth range, six still smaller plates in the fifth range, and eight small plates in the sixth range, that form the top of the calyx between the arm bases and unite with the plates of the vault, in a zig zag line. Whether or not the plates in the other two areas are the same cannot be determined from our specimen.

The intersecondary areas are short, but almost like the interradial areas, in the upper part, and the plates consist of four ranges. The first one, consisting of two plates, rests between the upper slightly sloping sides of the second secondary radials and in line with the third range of interradials; it is followed by four plates in the second range, six in the third range and eight in the fourth range, that unite with the plates of the vault, in a zig zag line. The sutures are so obscure between the small plates, in some of the areas, that it cannot be determined whether or not all the areas are exactly alike. The arms are separated about equally distant from each other, whether by the interradials or intersecondary radials.

There seems to be no azygous area in the calyx.

The vault, in our specimen, as may be seen in the illustration, is broken away at the summit. It is, however, highly convex, the convexity probably equalling the height of the calyx, and covered with ornamented polygonal plates arranged in peculiar and systematic order. The sutures are distinct, even between the smaller plates, and the edges of the plates are beveled, and between the larger plates the sutures are widely grooved. The plates are depressed convex, concave in the center and more or less sculptured and granulous. The smaller plates are over the arm furrows and regularly interlock. The plates toward the central area are large and polygonal. The plates in the interradial areas are elongated and arranged fan like, in some of the areas, and more like a keystone arch in others, which have a very long, wedge shaped plate in the middle. There are eight or ten plates in each depressed interradial area. A horizontal furrow crosses the top of each of the last plates of the calyx and penetrates the vault at the suture between the plates of the interradial areas. There are, therefore, eight or ten horizontal elongated pores or passages that penetrate the vault between each of the arms. They are shown in the illustration. This subject will be further considered in remarks at the close of the descriptions of *Dolatocrinus* in this article.

Found in the Hamilton Group, at Louisville, Ky., and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS ORNATUS *var.* ASPERATUS, n. *var.*

Plate II, Fig. 4, basal view, Fig. 5, view of the vault; Fig. 6, side view.

Calyx low, basin shaped, flattened or truncated at the base as far as the extent of the second radials; columnar cavity small; primary radial ridges prominent; surface of all the plates closely and radiately sculptured and pitted.

Basal plates hidden by the column, which is round and pierced with a cinque-foil canal. First primary radials longer than wide and only a small part at the lower end is curved into the columnar cavity. Strong radial ridges rise on the first radials, cross the second and terminate at a tubercle on the third radials, from which a delicate ridge crosses each secondary radial. The radial ridges are most prominent in the central part of the plates. The radiating lines from the commencement of the radiating ridges form a pentagonal figure around the small columnar cavity. Second primary radials quadrangular and wider than long. Third primary radials larger than the second, wider than high, pentagonal and support on each upper sloping side two secondary radials.

First secondary radials about as large as the third primary radials and hexagonal, except in some instances, where slightly truncated by a small plate resting between the upper lateral side of the second interradial and the base of the arm, they become heptagonal. Second secondary radials much smaller; they separate the arms and extend to the summit of the calyx and slope laterally. There are ten arms, composed, at their origin, of a double series of plates. No intersecondary radials.

The first interradials are the larger plates of the body and have nine sides. The second interradials are less than half as large as the first and hexagonal; the three superior sides are the shorter ones; the upper truncated side extends to the summit of the calyx and a small vault plate abuts laterally against it. A small plate rests between each superior lateral side and the second secondary radial and forms part of the support of the free arm. There is no azygous area.

The vault is only slightly convex and very much depressed in the interradial areas, especially between the arm bases. It bears a small subcentral proboscis that is not preserved in our specimens. It is covered with rather large, polygonal, tuberculated plates, two of which, in each depressed interradial space, are elongated, and the larger plates of the vault. There are no pores or passages that penetrate the vault between the arms.

Found in the Hamilton Group, near Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS ORNATUS, Meek.

Plate II, Fig. 7, basal view; Fig. 8, summit view; Fig. 9, side view of the same specimen from Columbus, Ohio.

The following is the definition of this species, by Meek, from the Proceedings of the Academy of Natural Sciences of Philadelphia, 1871, p. 57. It has never, before, been illustrated.

"Body including the vault, depressed subglobose, the portion below the arm bases being a little higher than the vault, with nearly vertical sides above, but rounding under below to the somewhat flattened under side; arm bases protuberant, mainly in consequence of the rather deep furrows or sinuses of the vault over the interradial areas; vault composed of irregular pieces, each of which projects in the form of a little sharply prominent node or short spine, the largest of which are situated around the nearly central ventral tube, and on the elevations between it and the arm bases. Base small, a little compressed within the shallow concavity of the under side, and marked by a distinctly indented column-facet, which occupies near three-fourths of its entire breadth, so that only a narrow ring, as it were, of the basal pieces can be seen when the column is attached. First radial pieces comparatively large, extending out nearly horizontally, or only a little arching upward, and with their inner ends curving slightly into the shallow central concavity; all wider than long, and hexagonal, with the upper (outer) side of each longer than any of the others. Second radial pieces about half as large as the first, wider than long, and quadrangular in outline. (In one ray of the typical specimen the second radial is abnormally wanting, while the third is larger than usual.) Third radials about as large as the second, from the curved-up edges of which they rise vertically wider than long, and pentagonal in form; bearing on each of their superior sloping sides a smaller secondary radial, each of which supports another smaller, more or less cuneiform piece, from which the arms arise; thus making two arms from each ray, unless the number is increased by bifurcations after they become free; arms unknown, but apparently composed, at their origin, of a double series of alternating pieces.

"First interradial pieces, somewhat larger than the first radials, about as wide above the middle as their length, eight or nine sided, with the lower part of each curving under to connect with the first radials, while they curve upward vertically from near or below the middle; each supporting on the upper side a much smaller hexagonal piece, which rises vertically, and usually bears on its short superior lateral edges two smaller pieces connecting with the secondary radials or first arm-pieces, while its short truncated upper side is not surmounted by any succeeding piece, but connects on its inner surface with the vault.

"Sutures between all the plates channeled. Surface of body plates ornamented with raised lines or very small radiating costæ, that cross the sutures parallel to each other at the sides of the plates, but soon become bent about and connected, in various ways, so that very few of them extend directly to the middle of any of the plates, the arrangement being such as to produce a kind of vermicular style of ornamentation, especially over all the central part of the plates, like that often seen on the body plates in *Amphoracrinus.* A small rather sharp ridge also extends up the middle of each radial series of plates, more or less interrupted at the sutures, and showing a slight tendency to form a pinched node on the middle of the first and second radials; while it is sometimes seen to bifurcate on the third radial, to send branches to the secondary radials, but these are generally so small as scarcely to be distinguished from the other little ridges ornamenting all of the body pieces.

"Ventral tube unknown, but judging from the spiniferous character of the vault-pieces around its base, probably also spiniferous.

"Height of body to arm-bases, 0.47 inch. do. to top of vault, 0.60 inch; breadth, 0.95 inch."

The specimen illustrated is from the typical locality, in the Upper Helderburg Group, at Columbus, Ohio, and is from the collection of Charles Faber. It will be observed that it is about the size of the type described by Meek, and agrees with it in all particulars. The variety *asperatus,* above described, has a proportionally longer calyx, which produces some difference in the relative sizes of the plates, but this alone would not be of varietal importance; taken, however, in connection with the different surface ornamentation and the great difference in the ridges that cross the radial plates, varietal characters may exist. The plates on the superior lateral sides of the second interradials are proportionally smaller in *D. ornatus* than in *D. ornatus var. asperatus* and other minor differences might be pointed out, but they do not seem to us to constitute specific differences, though the two forms on cursory examination are readily separated. If the arms were preserved possibly the two forms could be specifically distinguished.

DOLATOCRINUS STELLIFER n. sp.

Plate II, Fig. 10, basal view; Fig. 11, view of the vault, only part of the sutures can be distinguished and the ornamentation is not preserved; Fig. 12, internal view of the calyx showing the basal plates and part of the first primary radials.

Calyx low, basin shaped, three time as wide as high, deeply and broadly concave below, the concavity extending to the middle of the first interradials; columnar cavity deep; radial ridges quite small. Surface of all the plates deeply, closely and radiately sculptured.

Basal plates extending in a cylindrical form up as high as the top of the calyx and completely hidden externally by the column, which fills the cylindrical area. The column is round and pierced with a cinque-foil canal. First primary radials longer than wide and together forming a funnel-shaped columnar cavity, ornamented near the top with two raised lines, forming a pentagon, with a furrow between them. Second primary radials a little wider than high, quadrangular, gradually expanding upward, and each ornamented with a small, sharp radial ridge that rises at an angle of the pentagonal ornamentation, on the first radial, and, crossing the second and third radial bifurcates at the superior angle of the third radial, from which point a broken ridge crosses each secondary radial series to the free arms. On each side of the radial ridges the plates are closely, deeply and radiately sculptured. Third primary radials shorter than the second, pentagonal, expanding upward to the lateral angles and supporting on each upper sloping side a secondary radial series.

There are four secondary radials in each of nine series, and they become smaller toward the arms, which commence, at the arm openings, with a double series of interlocking plates. They are radiately sculptured from a more or less well defined central node. One secondary radial series in our specimen consists of a single pentagonal plate which bears upon each of the upper sloping sides a tertiary radial series having three plates before reaching the double series of interlocking plates, at the base of the arms. There are, therefore, eleven arms composed at their bases of a double series of interlocking plates.

The first interradials are the larger plates of the body and have nine sides. They are deeply stellate in their ornamentation. The second interradials are more than twice as wide as high and apparently heptagonal as the two superior sloping sides of each appear to bear four small plates that separate the second and third secondary radials. These plates are followed by two plates that separate the fourth secondary radials, and upon the superior lateral sides of these plates there is a single small plate, on the side of the arm base, that appears to properly belong to the calyx. There are, therefore, ten regular interradials if the last two small plates above mentioned are to be regarded as interradials. The sutures between the intersecondary radials cannot be distinguished in our specimen, but, from the ornamentation, it is inferred there is one small plate in the first series and two in the second. No azygous area has been determined.

The vault is moderately and evenly convex, with very slightly concave interradial spaces and a small, long subcentral proboscis. It is covered with rather large polygonal plates, the ornamentation of which is destroyed in our specimens. The plates in the interradial areas are elongated and arranged in fan-like order. A horizontal furrow crosses the top of each of the last plates in the calyx, except the minute ones abutting the arm bases, and penetrates the vault at the suture between the plates of the interradial and intersecondary radial areas. Our specimens disclose four of these horizontal elongated passages in each interradial area and two in each secondary interradial area.

A glance at the vault of this species will at once distinguish it from *D. ornatus, D. ornatus var. asperatus* and all other described species. Beside it is remarkable for the comparatively low calyx, broad and deep basal concavity and dense stellate sculpturing of the surface.

Found in the Hamilton Group, at Louisville, Ky., and at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS BULBACEUS n. sp.

Plate II, Fig. 13, basal view; Fig. 14, summit view; Fig. 15, side view.

Calyx and vault together bulbous. Calyx pentagonal from base to the arms, somewhat bowl-shaped, most expanded in the middle part, slightly constricted below the arms; columnar cavity deep. Surface marked by strong radial ridges, and a prominent node in the central part of each first interradial from which radiating ridges extend to the adjoining plates.

Basal plates almost hidden by the column though extending a little beyond it. First primary radials about as long as wide and abruptly bent in the middle, the lower part forming part of the funnel-shaped columnar cavity andthe upper end curving as abruptly upward. In the center of each there is a prominent node, from which the radial ridges arise, and which are connected by straight ridges, from one to the other, that form the pentagonal outline of the base, and on which the calyx will rest, if placed on a level surface. Second radials quadrangular, very little wider than high and sides nearly or quite parallel. Third primary radials about twice as wide as high, expanding from below to the lateral angles, pentagonal and supporting upon each of the superior sides two short, secondary radials.

The first secondary radial is much larger and wider than the second and abuts one side against a truncated corner of a first interradial and another against the secondary interradial. The second secondary radials abut against each other, are rounded externally and assume the form of the arms. The arms in each radial series are thus arranged close together, and the arm openings are directed upward. There are only ten arms, and they consist, as we infer from the commencement, of a single series of plates.

The first interradials are the larger plates of the body and have nine sides. They are convex centrally and have a prominent central node from which ridges radiate to adjoining plates. The second interradials are about half as large as the first, bear a central tubercle, are heptagonal, abut laterally upon the first secondary radials, and a small plate that separates the first and secondary radials from the plates of the vault and forms part of the base of the arms, and the two superior sides abut two interradial plates belonging to the vault.

The vault is quite convex, depressed in the interradial areas and bears a subcentral proboscis. It is covered with only a few large, polygonal plates, the surface ornamentation of which is not preserved in either of four specimens examined. There are no pores or passages that penetrate the vault between the arms and there does not seem to be any azygous side.

The general form of this species will readily distinguish it from all others that have been described, but it will be noticed that the number and arrangement of the plates of the calyx is the same as in *D. ornatus* even to the abutting of the second interradials upon the two vault plates, without pores or passages between the arms, though otherwise the vaults are quite different.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS VENUSTUS, n. sp.

Plate II, Fig. 16, basal view; Fig. 17, side view; Fig. 18, summit view.

Calyx hemispherical, surface ornamented with radiating ridges and nodes; radial ridges sharp, prominent and interrupted at the sutures. Column large.

Basal plates almost covered by the column. First primary radials wider than long and not extending into the columnar cavity. Second primary radials a little wider than high, quadrangular, sides nearly parallel. Third primary radials a little shorter than the second, pentagonal, expanding to the lateral angles and except two, supporting upon each of the upper sloping sides a single secondary radial; two of them bear four secondary radials each.

Eight of the secondary radials bear upon each upper sloping side three tertiary radials; they grow gradually smaller, and the last ones are followed by cuneiform plates that belong to the arms. There are, therefore, eighteen arms in this species, four in each of three radial series and three in each of the other two series. The arms are composed of a single series of cuneiform plates.

The first interradials are the larger plates of the body and have nine sides. The second interradials are less than half as large as the first and they are each followed by three plates, a small one on each side at the base of the arms and a large one that unites with two plates in the interradial depression on the vault. There seem to be no intersecondary radials. There is no azygous area.

The vault is only slightly convex and moderately depressed in the interradial areas. It bears a long subcental proboscis. It is covered with large polygonal plates that are densely covered with tubercles and short spines. The tubercles are not shown in the illustrations because there are from twenty to fifty on each plate. The two interradial plates in each area that abut upon the last interradial in the calyx are elongated, and the larger plates of the vault. There are no pores or passages that penetrate the vault between the arms.

The hemispherical form and peculiar surface ornamentation distinguish this species. Beside, the number of arms is different from all related species. The number of plates and general order of their arrangement in the calyx, however, are like those in *D. ornatus* and *D. bulbaceus*, notwithstanding the wide variation in the forms of the three species.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS AUREATUS n. sp.

Plate III, Fig. 1, basal view; Fig. 2, side view; Fig. 3, summit view.

Calyx hemispherical. Surface ornamented with radiating ridges, usually broken, and nodes; radial ridges sharp and more or less interrupted at the sutures. The sculpturing is more dense than shown in the illustrations. Column round.

Basal plates display a pentagonal rim around the column, where it enters the concavity formed by the basal plates. First primary radials wider than long and abut upon the basal plates without entering the columnar cavity. Second primary radials about twice as wide as long, quadrangular, sides nearly parallel. Third primary radials about half as long as wide, pentagonal, expanding to the lateral angles, and except three, supporting upon each of the upper sloping sides a single secondary radial; three of them bear three secondary radials each.

Seven of the secondary radials bear upon each upper sloping side two tertiary radials, the last one of which is followed by the cuneiform plates that belong to the arms. There are, therefore, seventeen arms in this species, four in each of two radial series and three in each of the other three series. The arms appear to be composed of a single series of cuneiform plates.

The first interradials are the larger plates of the body and have nine sides. The second regular interradials are about half as large as the first and they are each followed by three plates, a small one on each side at the base of the arms and a large one that unites with two large plates in the interradial depression on the vault. There are no intersecondary radials. There is, however, a distinct azygous area shown in our specimen on the side nearest the proboscis. The first and second interradials are like those in the other areas, but the second plate is followed by four or five plates (the sutures are not all distinct), that separate the arms, one-fourth more than they are separated in the other areas, and these unite with three or more plates of the vault, instead of with two as in the other areas.

The vault is moderately convex and depressed in the interradial areas. It bears a long subcentral proboscis on the azygous side. It is covered with large polygonal plates that are densely covered with tubercles. The two interradial plates, in each regular area, that abut upon the last interradial in the calyx, are elongated and the larger plates of the vault. There are no pores or passages that penetrate the vault between the arms.

This species most resembles *D. venustus*, from which it is distinguished by having seventeen instead of eighteen arms, and by having an azygous area. The surface ornamentation, too, is different, but on that ground alone we would not be justified in founding a new species in this genus, for we are satisfied the sculpturing is not uniform on specimens belonging to the same species.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS APPROXIMATUS, n. sp.

Plate III, Fig. 4, basal view; Fig. 5, summit view; Fig. 6, side view, showing the three armed radial series.

Calyx bowl-shaped; truncated below; slightly constricted below the arm bases; pentagonal, funnel shaped columnar pit, bounded externally by a raised ridge running from a central tubercle on each first radial to a central tubercle on the adjacent first radials; column round, perforation small, cinque-foil. Surface ornamented by rather strong radial ridges commencing at the central node on the first primary radials and extending to the arms, and by radiating ridges from a central node on each plate.

Basal plates sunken and so nearly covered by the column as not to be visible externally. First primary radials about as long as wide, one-half the length being in the columnar cavity. Second radials, quadrangular, wider than long, flattened and bearing a prominent central node. Third radials, pentagonal, expanding to the lateral angles, wider than high, four of them bearing upon each upper sloping side four secondary radials and the other one bearing upon one upper sloping side four secondary radials and upon the other a single secondary radial which bears upon each of the upper sloping sides three tertiary radials. Four of the radial series thus bear two arms each and the other bears three arms, making eleven arms in this species. From the arm bases it might be inferred that the arms are composed of a double series of interlocking plates, as there are two plates at the base instead of one, but two furrows are not seen to enter the vault.

First interradials the larger plates of the calyx and have nine sides. Second interradials less than half as large as the first, hexagonal, and support three small plates in the third range, which are followed by three smaller plates that separate the arm bases and unite with the plates of the vault. Intersecondary radials two, separating the arm bases and uniting with the plates of the vault. No azygous side.

Vault moderately convex, with a subcentral proboscis and composed of convex polygonal plates. Those in the interradial areas are elongated and disposed in a fan-like arrangement. Four pores or passages enter the vault in each interradial area, and two in each intersecondary area; they are continued by a shallow furrow across the top of the last range of interradials.

This species is more nearly related to *D. lacus* than to any other that has been described. It is distinguished, however, by having eleven arms instead of ten, which, alone, we regard as of specific importance. It is further distinguished by having one more secondary radial and one more interradial in the third range, which we think is of specific importance, especially as our specimen is much smaller than any specimen of *D. lacus* we have seen. The difference in size and in surface ornamentation we do not regard as of importance, especially where, as in this case, the two species have the same general form and without careful examination might be taken one for the other. A basal view of the two species is alike.

Found in the Hamilton Group, at Louisville, Ky., and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS LINEOLATUS, n. sp.

Plate III, Fig. 7, basal view; Fig. 8, side view; Fig. 9, summit view, the small plates near the arm openings are not distinguished.

Calyx hemispherical, very slightly constricted below the arm bases, which protrude nearly horizontally. Surface ornamented with fine radiating lines, in fascicles of three, that run from a sharp prominent node, in the center of each principal plate, to the central node in each adjacent plate. Radial ridges small, sharp, continuous over the sutures and bearing a sharp node at the center of each plate. Column round, rather small.

Basal plates almost covered by the column. First primary radials a little wider than long and not extending into the columnar cavity. Second primary radials about twice as wide as long, quadrangular, sides nearly parallel. Third primary radials longer and wider than the second; about twice as wide as long; expanding to the lateral angles, pentagonal and bearing upon the upper sloping sides the secondary radials. One of them bears upon each upper sloping side three secondary radials and each of the other four bear upon one upper sloping side three secondary radials and upon the other one a single pentagonal secondary radial that bears upon each upper sloping side two tertiary radials. There are, therefore, three arms to each of four radial series and two arms to the other one, making fourteen arms in all. The arm bases project nearly horizontally. The arms are composed of a single series of cuneiform plates.

The first interradials are the larger plates of the body and have nine sides. The second interradials are more than half as large as the first and reach to the summit of the calyx. This plate in the second range is followed by three plates, the central one is the larger and unites with two plates on the vault and the lateral ones form part of the arm bases. There are no intersecondary radials. There is no azygous area.

The vault is quite convex and much depressed in the interradial areas, which is made more conspicuous by the prominence of the ambulacral areas, at the base of the arms. There is a long subcentral proboscis. The vault is covered with large polygonal plates; the smaller plates over the arm furrows near the openings in the vault are not shown in the illustrations, because the sutures are not distinct in our specimens. It is rare that they are correctly exhibited in illustrations of other species, for the same reason. The plates are covered with tubercles, those near the base of the proboscis being somewhat spinous. The two interradial plates, in each area, that abut upon the three plates in the third range of interradials belonging to the calyx, are elongated and the larger plates of the vault. There are no pores or passages that penetrate the vault between the arms.

This species is distinguished by its general form, surface ornamentation and by having fourteen arms. It is probably as nearly related to *D. venustus* as to any other species.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS GREENEI, n. sp.

Plate III, Fig. 10, basal view; Fig. 11, side view; Fig. 12, summit view.

Calyx hemispherical, very slightly constricted below the arm bases. Surface sculptured in a variety of ways; there are prominent nodes in the central part of the larger plates from which there are radiating ridges and there are shorter radiating ridges that do not arise from the central nodes, beside scattering tubercles. The radiating ridges are interrupted at the sutures and ventricose in the middle part of the plates with a node at the center of each. Column round, medium size.

Basal plates expose a pentagonal rim around the column. First primary radials wider than long and of unequal size, two of them, on the azygous side, being much larger than the others, as shown in the upper part of Figure 10. Second primary radials only slightly wider than long, quadrangular, sides nearly parallel. Third primary radials, about the same length as the second, expand to the lateral angles, and bear upon each upper sloping side, except one, a single secondary radial. Upon one side of the radial series opposite the azygous side there are three secondary radials, the last one of which bears a cuneiform arm plate. The first secondary radials are large and bear upon each upper sloping side two tertiary radials. There are, therefore, four arms to each of four radial series and three arms in the radial series opposite the azygous area, making nineteen arms in this species. The arm bases are not large and the arms appear to be composed of a single series of cuneiform plates.

The first interradials are the larger plates of the body and have nine sides, in three of the areas; but, in the other two areas, there are two interradial plates in the first range and together they are much larger than the single first interradials. The two interradials in the first range in the two areas may be seen to abut upon the two large first primary radials in Figure 10, one plate extending below the other and one of them may be seen on the left of Figure 11. We cannot say that the two large first primary radials, followed laterally by two plates, in the first range of interradials, represent an abnormal development. We have only one specimen. The two first primary radials are substantially alike and the two peculiar interradial areas are substantially alike. If they are abnormal there is regularity about them, and they are each separated by a four-armed radial series from the three-armed series. There is only one plate in the second range, in three of the areas, and two in the other two areas. In the third range there are three plates, the central one is the larger and unites with two plates on the vault and the lateral ones form part of the arm bases. There are no intersecondary radials. There is an azygous side if we would embrace within it two radial series and three interradial areas, but there cannot be said to be a single azygous area as that term is applied in the description of crinoids.

The vault is only slightly convex but rather strongly depressed in the interradial areas between the arm bases. There is a small subcentral proboscis. The vault is covered with rather large polygonal plates, the two, in the interradial areas that abut upon the plates in the third range of the interradials, are elongated and the larger plates of the vault. All the plates bear tubercles and a few of them bear a central spine each that is surrounded with tubercles. There are no pores or passages that penetrate the vault between the arms.

This species is distinguished by its wide calyx, low vault, peculiar form, surface ornamentation and number of arms.

Found in the Hamilton Group, at Louisville, Ky., by G. K. Greene, in whose honor the specific name is proposed, and now in the collection of S. A. Miller.

Remarks.—We have described and illustrated fourteen species of *Dolatocrinus*, being all that are now known from Ohio, Indiana and Kentucky. Eleven of these are new to science, one of the others has never before been figured, and the other two are illustrated and redescribed for the purpose of showing characters not heretofore known. We call attention to the fact that no one has discovered an azygous opening in any of the species, and this important character or part of the ordinary structure of crinoids may fairly be said not to exist in this genus. *D. magnificus* and *D. aureatus* have each an azygous side to the calyx and vault and *D. greenei* has two azygous areas in the calyx, while none of the other species have an azygous side or azygous area.

D. grandis, *D. lacus*, *D. marshi*, *D. stellifer* and *D. approximatus* have orifices entering the body through the vault, between the arms, an important structure having no existence in *D. magnificus*, *D. ornatus*, *D. ornatus var. asperatus*, *D. bulbaceus*, *D. venustus*, *D. aureatus*, *D. lineolatus* or *D. greenei*, and whether or not the character belongs to *D. spinosus* is not determined. These orifices, though conspicuous in the species to which they belong, have not, so far as we are advised, been heretofore mentioned, and it would seem, therefore, appropriate for us to state more fully the structure and appearance and the possible or probable physiological functions with which they were connected.

We regard them as excurrent orifices for the reason that they cross the plates of the calyx at the summit by a furrow and enter the vault horizontally, which is inconsistent with any other hypothesis. What flowed through the orifices flowed through the channels across the thickness of the plates of the calyx, for we cannot conceive of any other utility or purpose of the furrows. Nothing could have flowed through the furrows and entered the orifices for the purpose of gaining access to the interior of the body, for there was no means of propelling anything in that direction. Endosmosis would not take place in that way.

They may have been used as conduits for the waste material that entered through the ambulacral furrows, or for the discharge of surplus water, but whatever their purpose they must have been used in the performance of some important physiological function. There would seem to be no doubt of that fact. This conclusion leads us to ask why, if they were so important to the species possessing them, did the greater number of species in the genus exist without them? The question is unanswered and at present unanswerable, because the physiological functions performed, at the seat of life, which is supposed to have been near the central part and on a level with the top of the calyx, in this genus of palaeozoic crinoids, are not known. The orifices are elongated externally and in their passage through the vault, because they are directed horizontally through the convex vault, and the elongation, therefore, depends upon the convexity of the vault in the different species.

CRINOID BASES.

Plate III, Fig. 13, superior side of an eroded base; Fig. 14, inferior side of same.

Crinoid bases are as full of pores as sponges and, when silicified, they may be cleaned with acid and made to expose the pores as shown in the illustrations. Weathered specimens, when not silicified, expose the pores, and a broken fragment will expose them also. Unaltered and finely preserved specimens do not expose the pores externally. The column is inserted in an obconoidal cavity in the base and the pores radiate from this cavity in all directions to the farthest extremities of the base. They are rarely larger than an ordinary sewing needle, and generally less in size, but so numerous that the interspaces have a diameter but little more than the diameter of the pores. The radiating pores are more or less sinuous and accommodated to the irregularities of the base.

These pores, as we suppose, were connected with the columnar canal and through them the material passed that formed the base. The histogenesis of the base may be compared with the formation and development of the bones of an animal. The mucous or fluid substance, that contained the material for the base, passed through the columnar canal into the pores of the base and was deposited in a softer state than it afterward assumed. In this way the base increased in size with the growth of the animal, and was made to fill the inequalities of the surface, to which it attached, and to extend over the border so as to form hooks or anchors of support. The nutrition for the formation of the organic structure of the base was furnished in the same manner that it was supplied for all other parts of the skeleton of a crinoid. The pores of the base were channels for nutrition and were appropriated exclusively to the construction and support of it.

The plates of a crinoid column were enlarged with the growth of the animal, as bones and shells are increased in size; but new plates seem to have originated exclusively at the lower end, or within the obconoidal cavity, in the base, at the end of the column; none appear to have been intercalated between older plates and none were added at the superior end of the column. The columnar canal was, therefore, a channel for nutrition, and nothing passed into it except the digested and reparatory juices for the columnar cords or tendons and the skeletal plates and base.

The base illustrated is from the Hamilton Group, at Louisville, Ky., but it does not differ in organic texture or structure from bases found in other groups of rocks.

FAMILY ICHTHYOCRINIDAE.

LECANOCRINUS OSWEGOENSIS n. sp.

Plate III, Fig. 15, view on the right of the ray on the azygous side; Fig. 16, azygous side; Fig. 17, view of the ray between the azygous area and the area shown in Fig. 15, and which bears four primary radials.

Species small, subelliptical in general outline. Calyx obconoidal, bulged on the right of the azygous area, truncated for a small, round column, which is composed of thin plates, exposing the serrated edges for the union of the plates, and having a very small columnar canal. Plates of the calyx slightly convex and covered with granules; sutures distinct.

The three basals form a low pentagonal cup, about twice the diameter of the column. The subradials are of unequal size, the one below the azygous area is the larger and has seven sides, two of the others are hexagonal and two pentagonal. There are four primary radials in the series on the right of the azygous area and three in each of the other series. The first primary radials are unequal in size, the one on the right of the azygous area being the smaller and having only five sides, the others are hexagonal or heptagonal, depending upon whether they are truncated upon one or both superior lateral angles by the first interradials. The second primary radials are short and wide and of very unequal size, the one on the right of the azygous area is the larger and is hexagonal, the others are subquadrangular, but when a superior lateral angle is truncated by a second interradial they become pentagonal. Four of the third primary radials are short, wide, pentagonal and bear upon the upper sloping sides the secondary radials or free arms; the other third primary radial is short, wide, subquadrangular though slightly truncated at the superior lateral angle on the azygous side, so as to make it pentagonal; and it is then followed by a fourth primary radial which is pentagonal and axillary, and bears upon the upper sloping side the secondary radials or free arms. The arms preserved in our specimen have three short, secondary radials, in each, the last one of which is pentagonal and supports, on each upper sloping side, a third series of plates.

There are two small regular interradials in each area, one above the other; the first one separates the second and third primary radials, in each series, in some of the areas, it truncates the superior angles of the first primary radials, in others it does not extend so low. The first azygous plate is rather larger than the first primary radial on the right and has eight sides; it truncates a subradial, abuts upon three primary radials on the right, though the third one truncates the angle only slightly, two on the left, and is followed by two plates on the superior side, the one on the left being quite small. The larger plate in the second range is succeeded by a small plate on the right, which is all that is preserved in our specimen, but the facet for another plate in the middle part is well preserved. The azygous area, therefore, has five or more plates.

This species is readily distinguished from all others by the general form, regular interradial plates, azygous interradials and series of four primary radials in one of the rays. It is wholly unnecessary to compare it with any of them, though it clearly belongs to this genus.

Found in the Niagara Group, at Oswego, Illinois, and now in the collection of Wm. F. E. Gurley.

FAMILY **ACTINOCRINIDAE.**

MEGISTOCRINUS EXPANSUS n. sp.

Plate III, Fig. 18, basal view of a large specimen; Fig. 19, summit view of the same; Fig. 20, side view of the same; Fig. 21, basal view of a small specimen showing the commencement of the horizontal arms.

Calyx very shallow; broadly basin-shaped; from three to five times as wide as high; columnar cavity, evenly concave, commencing from about the middle of the second radials, the superior part of which curve upward; the calyx continues to expand from the second radials to the arms, expanding more rapidly as the arms are approached. The arms are directed horizontally. The column is round and of medium size. The vault is one-half higher than the calyx and has twice the capacity.

The basal plates have an hexagonal outline, about one-half wider than the diameter of the column. The first primary radials abutting on a single basal plate are hexagonal, those abutting on two basals are heptagonal. The second primary radials are a little larger than the first and hexagonal. The third primary radials are about the size of the first, pentagonal, and support upon each upper sloping side secondary radials.

The external surfaces of all the plates covering the three specimens at hand, one of them being intermediate in size between the two illustrated, are more or less eroded or disintegrated. The best preserved plates are beveled at the sutures, and it is, therefore, believed that specimens having a well preserved external surface will show distinctly the outlines of all the plates. In our specimens the sutures of the secondary and tertiary radials and those of the vault are generally obscure; some of them are, however, distinct. This is the reason the illustrations are not made to show all the plates, and, for the same reason, there is a little doubt about the number and shape of some of the plates just below the top of the calyx.

The first secondary radials are nearly as large as the third primary radials. In one of the lateral rays on each side there are no tertiary radials. In each of these two rays the second secondary radials are somewhat smaller than the first and extend to the lower part of the commencement of the enlargement for the arms. There are three or four more plates in each series, forming the base of the arms, before the arms become free. This gives us five or six secondary radials in each series, and two arms to each of these rays. In the other three rays there is only a single secondary radial in each. It is pentagonal and supports upon each of the upper sloping sides tertiary radials. There are four or five tertiary radials in each series, the last three or four of which form the base of the arms before they become free. The last two or three plates in each of the radial series are more or less cuneiform before the arms become free. There are, therefore, four arms to each of three rays and two arms to each of the other two rays, making in all sixteen arms to this species. The arms are composed of a single series of cuneiform plates.

In the interradial areas there is one hexagonal plate separating the second primary radials, and two plates in the second range separating the third primary radials, each of which is about the size of the primary radials. There are three plates in the third range, three in the fourth and three in the fifth; the last form a sharp ridge between the arm bases, which rises above the vault plates, that abut against it. In the intersecondary areas there is one plate in the first range and two in the second; the latter form a sharp ridge between the arm bases, which rises above the vault plates that abut against it. First azygous plate in line with the first primary radials and of the same size; it is followed by three plates of the same size as the first radials. Above these the area and arrangement of the plates is very much like the regular areas, with about one more plate in each range.

The vault bears a large central plate with a big conical spine. There is also a spinous plate over the junction of the ambulacral furrows in each series, making six spinous plates on the vault. The plates that cover the vault are polygonal and of very unequal size. There is an orifice on the azygous side of the central spine. The ambulacral areas are raised into rounded ridges and the interradial areas are depressed between the arms. The surface of the plates, in our specimens, is destroyed and the larger number of the sutures are not discernable.

This species is distinguished, by its general form, from all others. The broad shallow calyx, high convex vault, and horizontal arms will alone distinguish it. The number and arrangement of the arms is also a distinguishing feature as well as the surface of the plates, for most species from rocks of the same geological age, have highly convex or subspinous plates in the calyx.

Found in the Hamilton Group, at Louisville, Ky., and now in the collections of the anthors.

AN INTERESTING LETTER.

There is a letter, on file in the State Museum of Natural History of Illinois, belonging to the Geological Department, from Charles Wachsmuth, dated, at Burlington, Iowa, August 9, 1892, containing the following paragraph:

"I have described the *Eucalyptocrinus lindahli* and have sent the description, together with that of some other new species from the Niagara Group to the American Geologist for early publication, to secure priority, as I am aware that S. A. Miller will be out this fall, on some of the same species. This, of course, is confidential, for I do not want Miller to know it."

There was no more sympathizing place, for the publication of such material, than the American Geologist, a journal that never aspires to a higher level in scientific matters.

PLATE I.

	Page.
Dolatocrinus magnificus, n. sp.	5
Fig. 1. Basal view of a calyx somewhat injured near middle part.	
Fig. 2. Vault, a part being broken away.	
Fig. 3. Lateral view of calyx, showing six-armed ray and height of vault.	
Dolatocrinus spinosus, n. sp.	8
Fig. 4. Basal view of a calyx.	
Fig. 5. Lateral view of calyx showing some of the spines on the plates of the vault.	
Dolatocrinus lacus, Lyon	9
Fig. 6. Lateral view of a calyx.	
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Dolatocrinus marshi, Lyon	11
Fig. 8. Basal view of a calyx.	

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 4. **Plate I.**

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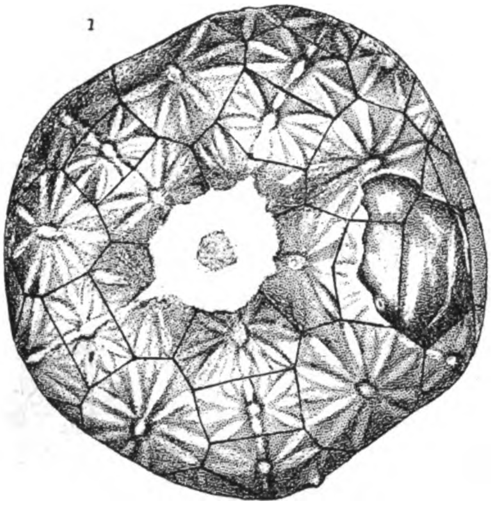

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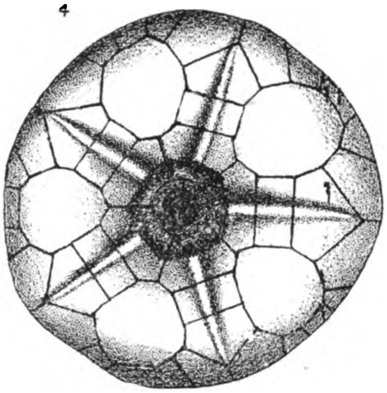

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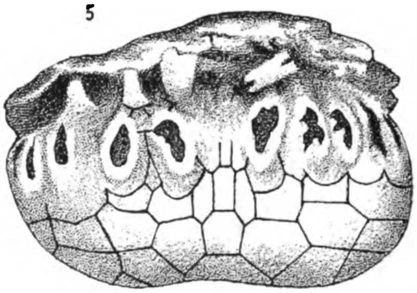

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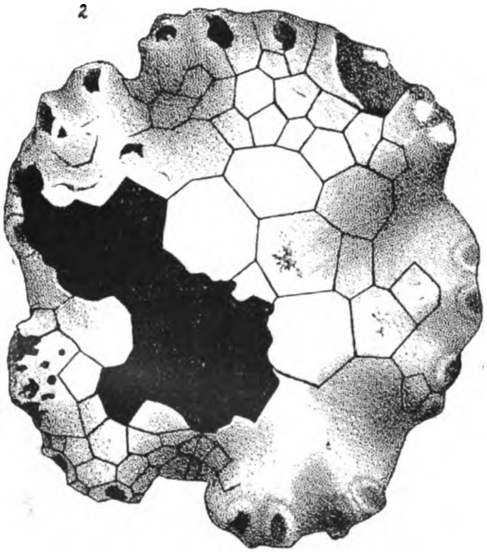

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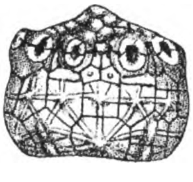

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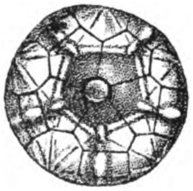

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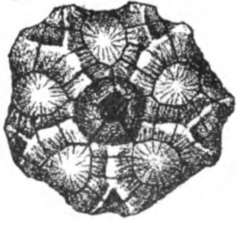

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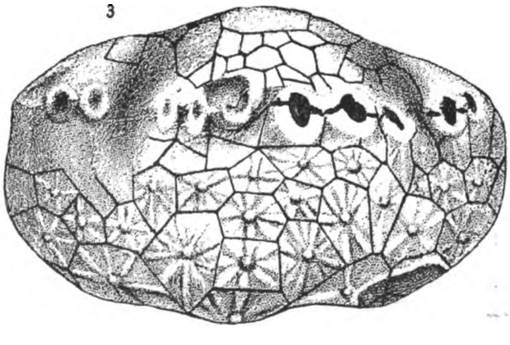

H. HUNT, DEL.

PLATE II.

PAGE.

DOLATOCRINUS GRANDIS, n. sp. 14
- Fig. 1. Basal view of a calyx.
- Fig. 2. Vault, somewhat broken away near the center.
- Fig. 3. Lateral view of calyx.

DOLATOCRINUS ORNATUS VAR. ASPERATUS, n. *var*. 16
- Fig. 4. Basal view of a calyx.
- Fig. 5. Vault.
- Fig. 6. Lateral view of calyx.

DOLATOCRINUS ORNATUS, Meek. 18
- Fig. 7. Basal view of a calyx.
- Fig. 8. Vault.
- Fig. 9. Lateral view of calyx.

DOLATOCRINUS STELLIFER, n. sp. 20
- Fig. 10. Basal view of a calyx.
- Fig. 11. Vault.
- Fig. 12. Lateral view of a fragmentary calyx, showing interior of basals.

DOLATOCRINUS BULBACEUS, n. sp. 22
- Fig. 13. Basal view of a calyx.
- Fig. 14. Vault.
- Fig. 15. Lateral view of calyx.

DOLATOCRINUS VENUSTUS, n. sp. 23
- Fig. 16. Basal view of a calyx.
- Fig. 17. Lateral view of calyx.
- Fig. 18. Vault.

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 4.

Plate II.

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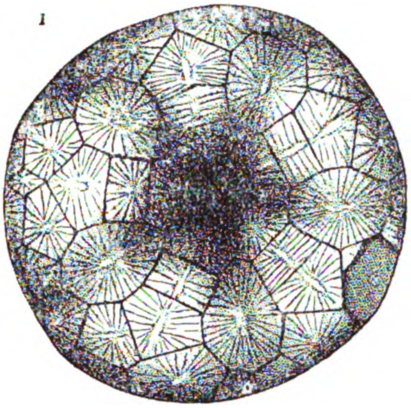

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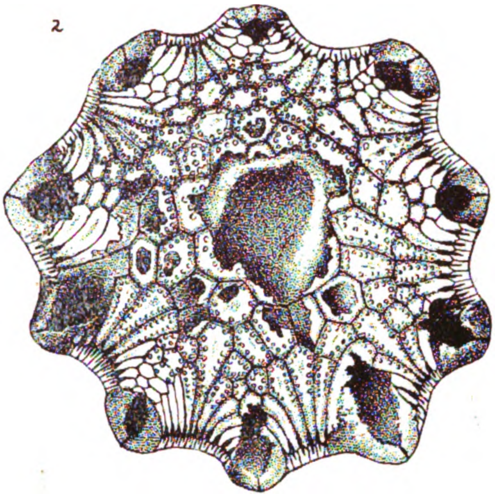

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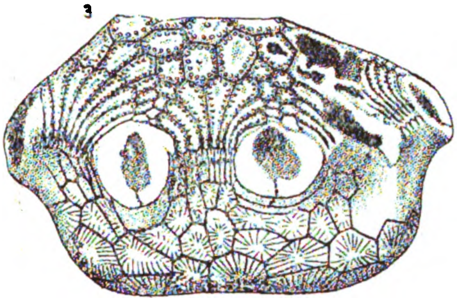

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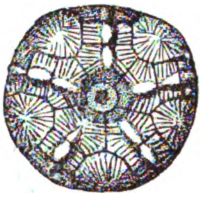

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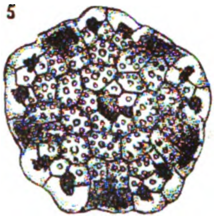

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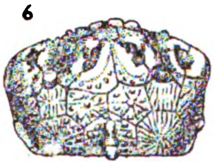

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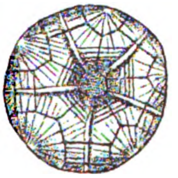

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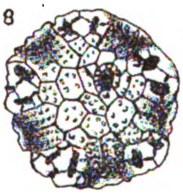

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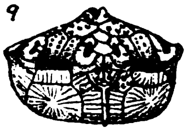

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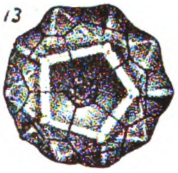

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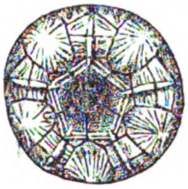

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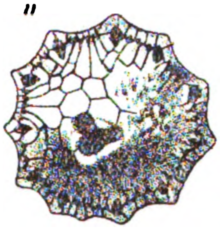

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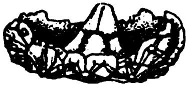

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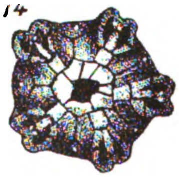

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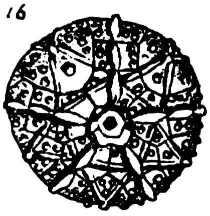

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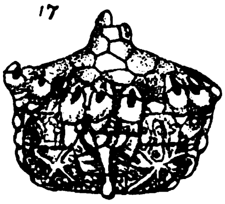

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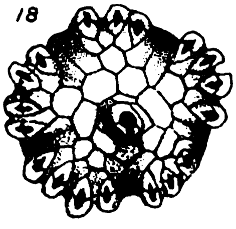

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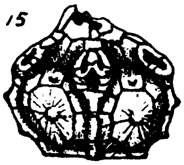

PLATE III.

PAGE.

Dolatocrinus aureatus, n. sp. 24
Fig. 1. Basal view of a calyx.
Fig. 2. Lateral view of calyx.
Fig. 3. Vault.

Dolatocrinus approximatus, n. sp. 25
Fig. 4. Basal view of a calyx.
Fig. 5. Vault.
Fig. 6. Lateral view of calyx.

Dolatocrinus lineolatus, n. sp. 27
Fig. 7. Basal view of a calyx.
Fig. 8. Lateral view of calyx.
Fig. 9. Vault.

Dolatocrinus greenei, n. sp. 28
Fig. 10. Basal view of a calyx.
Fig. 11. Lateral view of calyx.
Fig. 12. Vault.

Crinoid base 31
Fig. 13. Superior side of an eroded base.
Fig. 14. Inferior side of same.

Lecanocrinus oswegoensis, n. sp 33
Fig. 15. Lateral view showing area on right of the ray on azygous side.
Fig. 16. Azygous side view.
Fig. 17. View of the ray between the azygous area and the area shown in Fig. 15.

Megistocrinus expansus, n. sp. 35
Fig. 18. Basal view of a calyx.
Fig. 19. Vault.
Fig. 20. Lateral view.
Fig. 21. Basal view of a smaller specimen, showing the commencement of the horizontal arms.

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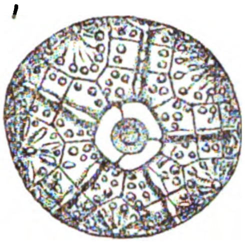

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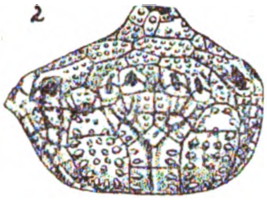

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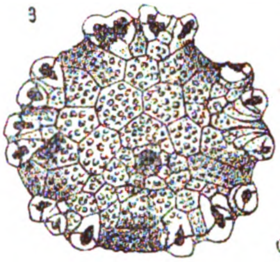

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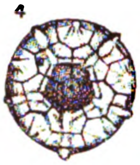

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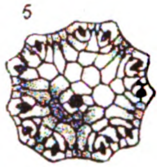

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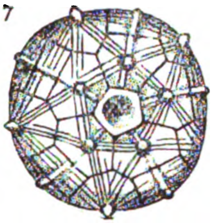

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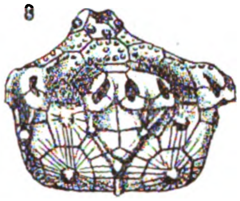

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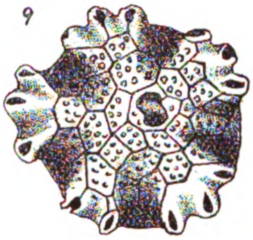

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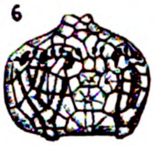

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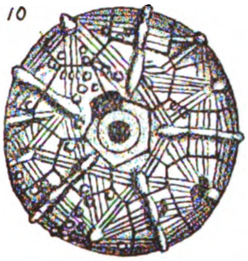

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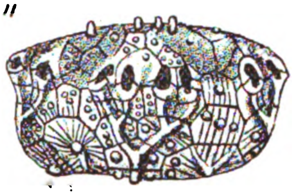

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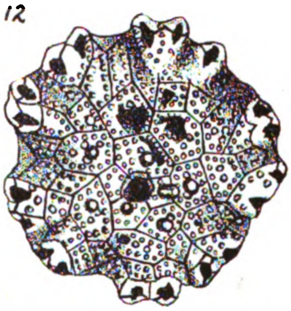

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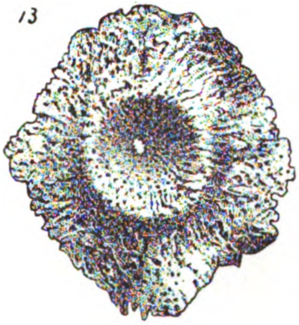

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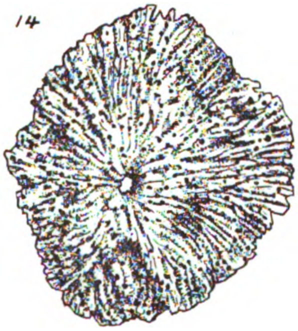

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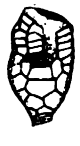

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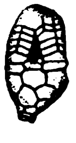

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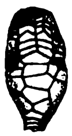

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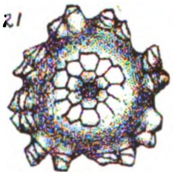

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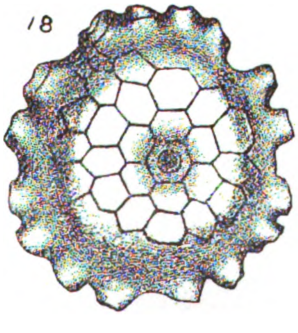

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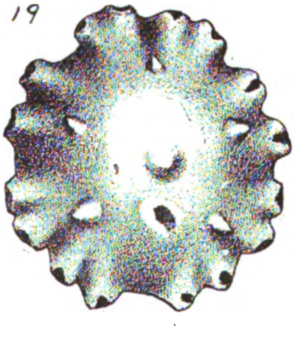

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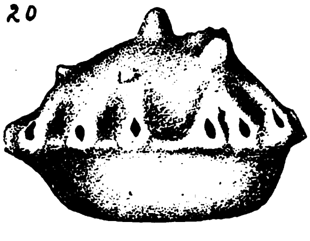

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BULLETIN NO. 5

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY

NEW GENERA AND SPECIES OF ECHINODERMATA.

5 plates

By S. A. MILLER and Wm. F. E. GURLEY.

Springfield, Illinois,
December 20, 1894.

SPRINGFIELD, ILL.
Ed. F. Hartman, State Printer.
1894.

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With Compliments of

PROF. WM. F. E. GURLEY,

STATE GEOLOGIST,

SPRINGFIELD, ILLINOIS, U. S. A.

HINODERMATA.

. GURLEY.

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JAN 8 1895

NEW GENERA AND SPECIES OF ECHINODERMATA,

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER CYSTOIDEA.

FAMILY HOLOCYSTIDÆ.

HOLOCYSTITES GYRINUS, n. sp.

Plate I, Fig. 1, ventral view; Fig. 2, posterior view; Fig. 3, summit view.

This species is large, and if the almost perfect specimen, which we have illustrated, possesses the normal form of complete development, then it became free in the later stages of growth, for a scar at the terminal point, indicates an attachment to some foreign object in a younger state. The specimen is a little depressed dorso-ventrally. It is broad and rounded at the summit, followed immediately below by a sac-like swelling, from which it is continued in an obconoidal form until it terminates in an obtuse point. The fanciful resemblance, in the general outline, to a tadpole suggested the specific name.

Commencing at the base or lower end, there is a solid obconoidal piece nearly as long as its greater diameter, which is followed by a range of eight unequal, irregular, and more or less elongated plates. Two plates are inserted between this range and the next on the right part of the ventral side. There are eleven large and elongated plates in the second range, and three plates are inserted on the posterior side, between it and the next range. There are thirteen large, irregular and elongated plates in the third range and nineteen plates in the fourth range. The fifth range consists of plates more irregular in their order of arrangement and still more variable in size. Above the fifth range the plates are not disposed in ranges nor in any other defined order, and differ so much in size and shape, that one can hardly say how many ranges they would make if disposed in some order. We would estimate, if they were in ranges, there are above the fifth range and below the mouth about seven or eight ranges; or between the basal piece and the mouth about twelve or thirteen ranges. Our specimen is most ventricose on the right side, and there is a base of a young cystidean at the lower side of the mouth and another immediately below one of the arm bases and some smaller bases on other parts of the body.

Looking at Fig. 3, the mouth may be seen on the upper side of the figure, two arm bases on the right and one on the left, connected by a Y shaped ambulacral furrow, and in the central part, between the mouth and the ambulacral furrow, what has been supposed to be the small anal opening. The mouth is on the margin of the anterior end and appears to have been surrounded by six plates, but the cystidean base covers the lower side of it, and hence, possibly, there are seven plates. The anal (?) opening is small and at the summit of a cone which is on the line of two plates. The ambulacral furrow is at the extreme summit and connects the three arm bases by following the sutures between the plates; the plates are denticulated or united by a zigzag line at the bottom of the furrow. Each plate that supports an arm is thickened and prominent and the ambulacral furrow is continued across this plate to the top of the prominence, where the cicatrix shows the place to which the arm was attached. The arms are not preserved. On each side near the bottom of the ambulacral furrow there is a row of pores, but a free plate of the same character from the same or a similar species, when examined from below, does not show these pores in lines, nor can they be distinguished from the other pores that penetrate the plate from all sides. The ambulacral furrow, therefore, is not homologous with the ambulacral furrows of either crinoids or blastoids. There is no reason to suppose that it was a food groove, was covered with minute plates, or was furnished with pinnules. It appears as a triangular furrow cut only half way through the plates, and where following the suture lines of plates, the plates are more firmly joined than elesewhere by the denticulated edges, but when it enters upon a plate that bears an arm, the furrow runs up to the base of the arm where it does not cut one-fourth of the thickness of the plate, and where the pores upon the sides appear to differ from the other pores that penetrate the plate only by being arranged externally in two lines. The physiological functions of this furrow are unknown.

We do not desire to be understood as laying any stress on the word *arms* used above, for so far, no arms, in the true sense, have been found in this genus. Instead of that we have had ambulacral spines, in some species, and in others no indications of spines. In this species there may have been only spines instead of arms possessing any kind of movement. All of the plates are poriferous, some much more densely poriferous than others; even the basal plate is poriferous. The pores generally penetrate the plates in pairs.

This is a remarkable species, on account of the Y-shaped furrow that connects the three arm or spine bases, and it is distinguished from all others by its peculiar form, size and the plates covering the body.

Found by J. F. Hammell in the lower part of the Niagara Group, in Jefferson county, Indiana, and now in his collection.

HOLOCYSTITES SPLENDENS, n. sp.

Plate I, Fig. 7, left anterior view or most ventricose side; Fig. 8, right posterior view or least ventricose side; Fig. 9, summit view.

This species is rather below medium size, balloon shaped or somewhat pear-shaped and our specimen is most ventricose on the left anterior side. It was sessile and the cicatrix for attachment is plainly preserved. The whole body is pustulose and every pustule is pierced by a pair of pores. There are also a number of large round cavities or hemispherical depressions irregularly distributed over the body, as shown in the illustrations, the purpose of which is wholly unknown. It has been supposed that they are marks of disease, and that the fact that the whole order of cystideans, soon after their great abundance in the Niagara Group, became extinct, gave color to the supposition, but we have no evidence that they are marks of disease.

Commencing at the lower end, we have, first, a small, round piece that attached to some foreign object, but which is papillose and pierced with pores just as the plates are above. It is followed by a range of eight small plates. There are eight larger plates in the second range and eight still larger plates in the third range without any intercalated plates. Between the third range and what may be called the fourth range there are twelve small plates, principally on the ventricose side. There are eight large plates in the fourth range. Above the fourth range the plates are polygonal of variable size and irregularly disposed. If they could be thrown into ranges there would be six or seven ranges between the fourth range and the mouth.

The ambulacral orifice is somewhat marginal, but at the summit. It is subpentagonal in outline, about twice as wide as long, and surrounded with seven plates. There are scars for five spines. Two plates separate the ambulacral orifice from the mouth. The mouth is hexagonal in outline and located subcentrally, or about one-half its diameter anterior to the center, and is lower than the ambulacral orifice. A large pustule on the plate adjoining the mouth and between it and the ambulacral orifice bears a large pore that is called the anal opening.

The specimen from which this species is described is almost as perfect, so far as the outer test is concerned, as it was the day the animal died. It is so different from all hitherto described that no comparison with any of them is necessary.

Found by J. F. Hammell, in the Niagara Group, near Madison, Indiana, and now in his collection.

Family ANOMALOCYSTIDÆ.

BELEMNOCYSTITES, n. gen.

[Ety. *belemnon*, dart; *Kustis*, bladder.]

Body compressed, moderately convex in the central part on both sides, but margin thin; outline ovoid. The plates are not disposed in ranges or series. A marginal rim of plates that covers an equal portion of both the dorsal and ventral sides is a peculiar character of this genus. Within this marginal rim there are a few large convex plates, on the dorsal side, without any arms or apertures. Within the marginal rim, on the ventral side, the plates are more numerous and an arm arises in the anterior part, but the openings are unknown. Column comparatively large composed of thin plates and tapering as in *Steleocystites.* Type B. *Wetherbyi.*

BELEMNOCYSTITES WETHERBYI, n. sp.

Plate I, Fig. 4, dorsal side of a specimen with part of the column attached; Fig. 5, dorsal side of another specimen with column and part of the plates broken off; Fig. 6, ventral side of same, part of the plates only being distinguishable.

In 1881 Professor A. G. Wetherby, in an article entitled "Descriptions of New Fossils from the Lower Silurian and Subcarboniferous Rocks of Kentucky," published in Jour. Cin. Soc. Nat. Hist., vol. 4, p. 177, pl. V, figs. 2 and 2*a*, called attention to a "new genus and species" of cystideans, without attempting to give it a name or determine its affinities. Fig. 4 is a reproduction of his figure 2, which is, evidently, the dorsal side of the specimen. He said of it: "The column is round and tapers rapidly. The peculiar character of this anomalous fossil is the presence of a single arm, originating between two large plates which form the apex of the body on the (ventral) side. Seven plates of the arm are shown. Near it, upon the left side, as shown in the figure, is a small tubercle, evidently formed by valvular plates now silicified so as to obscure their arrangement." Our specimen, as shown in figures 5 and 6, is just like his, except the lower part is broken away, and we have attempted to give a better view of the ventral side than is shown in his figure 2*a*. We have given him the honor of the specific name.

Body compressed, convex on each side, within the marginal rim of plates, outline subovoid, truncated at the base for the attachment of a large column, which is composed of thin plates and tapers rapidly.

There are nine plates in the marginal rim, not including the two which abut upon the column. Five on one side and four on the other. These plates are large and sutures distinct. The sutures are exactly opposite each other on the two sides and are plainly shown curving over the margin, which is thin and sharp. This peculiar rim of plates increases in thickness on the ventral side toward the central part of the body, which renders it probable that they are furrowed within so that a transverse section would be somewhat V-shaped, though they are depressed on the dorsal side. In no part of this rim is there any evidence of pectinated rhombs, pores or arms.

On the dorsal side of our specimen, there are only five plates preserved within the marginal rim, but figure 4 shows there are seven plates, two of which abut upon the column. The three superior plates are subconical. The outer surface is destroyed by silicification.

On the ventral side, there are evidently more plates within the marginal rim, but part of them cannot be distinguished, in our specimen, because the silicification has obscured the sutures. The ventral side is much more convex than the dorsal. The single arm to which Wetherby referred arises between plates, within the marginal rim of plates, and not from the apex of the body by any means. This is shown by his illustration as well as by ours. We cannot distinguish the arm plates, in our specimen, but the projection seems to be that of an arm. We are not able to distinguish any openings, but the tubercle, to which Wetherby referred, is on the left of what we have called the column, though it is not shown in our illustration, and we are not sure that it indicates anything beyond the convexity of the plate.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY CARYOCRINIDÆ.

CARYOCRINUS ELLIPTICUS, n. sp.

Plate II, Fig. 13, anterior side view; Fig. 14, summit view.

Species below medium size, subelliptical in outline, somewhat angular below, but round in the central part. Sharp ridges radiate from the center of the plates to each angle, except on the basal plates, where a sharp ridge runs from each of the two superior angles on each plate, to the point of columnar attachment. There is a single row of pores on each side of these angular ridges, but none elsewhere on the plates.

The four basal plates are of unequal size and form a cup less than one-third the length of the body. The strong longitudinal ridges give it an hexagonal outline. The base is rather deeply excavated for the insertion of the column. The six plates in the second range are of unequal size and the larger ones follow the smaller basal plates so that the symmetry of the body is restored, two are pentagonal, two hexagonal and two heptagonal. These plates bear sharp ridges radiating from the center to each angle. There are eight plates in the third range of unequal size and different in outline. The summit is covered with very convex plates. The mouth is near the margin, slightly elevated and surrounded by four convex plates, one of which is much larger than the others. The central plate is heptagonal and surrounded by seven plates. There are several smaller plates on the vault. There are nine arm openings to the vault.

This species is probably more nearly related to *C. indianensis* than to any other described species. It differs, however, in the general form and in the absence of the constriction below the arms. The third range of plates are not alike in the two species and the vaults are different. That species has twenty-one arms disposed in clusters; this one has only nine, and they are not in clusters. The plates of the vault in that species bear pores and pustules, while in this the plates are smooth and convex. There are pores and pustules between the radiating lines in that species and there are none in this. The surface ornamentation will readily distinguish the species as well as the general form.

The specimen illustrated is from the Niagara Group, at Osgood, Indiana, and is in the collection of S. A. Miller. Four specimens are in the collection of Wm. F. E. Gurley, from the Niagara Group, at St. Paul, Indiana, and they seem to differ only in bearing higher and sharper radiating lines.

CARYOCRINUS BULBULUS, n. sp.

Plate II, Fig. 15, anterior side view showing mouth at the summit and arm openings laterally; Fig. 16, posterior view; Fig. 17, summit view; Fig. 18, basal view of same.

Body bulbous, or subovoid, subpyramidal from the column to the middle of the second range of plates, where, by reason of the central protuberances on the plates, it is hexagonal; above this, it is less angular, but the mouth is produced above the rest of the summit, which is somewhat flattened behind the mouth. The surface, as it appears on our two specimens, one of which is unaltered limestone and the other silicified, is smooth. There are no radiating lines or ridges, granules or pustules and there are no pores that can be discovered with an ordinary magnifier.

The four plates, in the first range, form a subhexagonal cup about one-third of the length of the body, which has a small hemispherical depression at the bottom for the insertion of a column. The six plates in the second range are of unequal size, four are hexagonal, one pentagonal and one heptagonal; all are longer than wide, except the heptagonal plate, which is fully as wide as long. Each plate is subpyramidal externally, that is, produced centrally in the form of a node, which gives to the central part of the body its hexagonal outline. A cast, however; would not, probably, preserve this hexagonal outline and might be perfectly round.

There are eight plates in the third range of unequal size and different in outline. Two hexagonal plates stand nearly upright and abut upon the mouth, with their superior angles between the mouth and an arm opening on either side. Six of the plates rest between the superior lateral sides of the plates of the second range and two of them, each, truncate a single plate in the second range. The latter two are the smaller plates in the range. All of the plates of this range except where truncated by the mouth and arm openings abut upon the plates of the vault.

There is a subcentral plate on the vault, but the sutures between the plates in our specimens are not distinct, and we are not certain, therefore, as to the number of plates surrounding it; apparently there are only six, but probably there are seven. There are only six armholes that are clearly distinguishable on the limestone specimen, but there appear to be nine in the silicified specimen.

This species is widely separated from all hitherto described, but there is no doubt about the generic relations.

Found in the Niagara Group, in Wayne county, Tennessee, and now in the collection of Wm. F. E. Gurley.

ORDER AGELACRINOIDEA.

FAMILY HEMICYSTIDÆ.

AESIOCYSTITES, n. gen.

[*Ety. aisios*, auspicious, coming at a good time; *Kustis*, bladder.]

Body highly convex or hemispherical; free, not parasitic. We say free, because the plates preserved in our specimens are continued over the margin and part of the truncated side, and the arms also curve over the margin before they terminate. The truncated side is depressed in our specimens and is not preserved so as to offer an opportunity for an intelligent description. Plates of the interbrachial areas non-imbricating and not coalescing with the outer plates of the arms. Arms five, very large, highly convex, radiating from the center and curving over the margin before they terminate. They are composed externally of a double series of alternating and interlocking plates; when these plates are removed deep gutters are disclosed, which are angular at the bottom, and unite in an elliptical hole at the center, which connects with the visceral cavity below. The ambulacral furrows and central orifice are completely covered with the alternating and interlocking arm plates. One interbrachial area is larger than the others and the anal or ovarian pyramid is situated in it, eccentrically, approaching the margin.

This genus is readily distinguished from *Hemicystites*, which is a parasitic genus, composed of imbricating plates that coalesce with the arms, which are limited by a marginal rim of plates. Type *Aesiocystites priscus*.

AESIOCYSTITES PRISCUS, n. sp.

Plate II, Fig. 10, summit view with the outer plates of the arms silicified and showing the position of the anal or ovarian pyramid, Fig. 11, summit view with the arm plates removed and disclosing the arm furrows, the central orifice and the position of the anal or ovarian pyramid; Fig. 12, lateral view from which the external plates of the arms have been partly removed and showing the interbrachial plates.

The specimens upon which this genus and species are founded are silicified and the sutures between the plates more or less destroyed. The under side of all of them is broken in or damaged so that a full knowledge of it cannot be obtained.

The general form is hemispherical, with truncated margin rounded and radial ridges elevated and angular. It is composed of polygonal and non-imbricating plates, the largest of which are in the interbrachial areas. The interbrachial areas are distinctly defined on the convex side and the plates curve over the inferior margin and on the truncated side without interruption. The arms are very large, highly convex, and angular on the summit. They radiate from the center in such manner as to leave one interradial area larger than the others, with an arm directly opposite, and this lengthens the central arm elevation toward the two arms upon each side. The arms bend over the margin and then gently curve and terminate on the truncated side. Externally they consist of a double series of short alternating and interlocking plates, which cover large, deep and angular ambulacral furrows. The form of the plates in the bottom of the ambulacral furrows is not determined. The central orifice, from which the ambulacral furrows radiate, is sub-elliptical in outline, being lengthened with the central arm elevation and covered externally with the arm plates. The large area above described is the azygons area and the anal or ovarian pyramid and orifice is situated in it, eccentrically, near the margin

This species is founded upon four specimens, in two of which the external arm plates are removed, and one of these preserves a large part of the truncated side showing the curving and terminating ends of the arms. One of the other specimens shows part of the interlocking arm plates and the other shows the covering of the arm furrows almost complete. Whether there was a gaping of the arm plates at the ends of the rays or not is not determined, but it is quite probable that they did, as such is frequently found to be the case in Hemicystites.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY AGELACRINIDÆ.

AGELACRINUS LEGRANDENSIS, n. sp.

Plate III, Fig. 13, two specimens, natural size, the smaller one not as well preserved as the larger one; Fig. 14, same magnified two diameters.

The species in this genus seem to vary greatly in size, and we have no doubt the two specimens illustrated belong to the same species though the smaller one is not so well preserved as the larger and may not furnish all the evidence necessary to warrant a satisfactory conclusion in this respect. It is also quite probable that the larger specimen does not reach the maximum size of the species.

The body is circular and only slightly convex. The outer rim is composed of numerous small, squamiform, imbricating plates, those upon the outer margin of it are so minute as to be almost granular. The plates of the disc within the outer rim are also squamiform and imbricating and somewhat larger than any of the plates in the outer rim. There are only four arms, three of them curve slightly to the right and one to the left. The arms are slender and each consists of an angular ridge, composed of interlocking plates, and terminates after curving slightly on the inside of the outer rim. The central part from which the arms radiate is more convex than any other part of the body, but the plates are so small that no peculiar structure is discernable. The specimens are somewhat injured in the region of the aperture and apparently it is not at the center between the sinistral and dextral arms, but between that point and the central elevation.

This species is about the size of *Agelacrinus blairi* but the plates are smaller and the body is probably less convex. It is the only species yet known from the rocks of the Kinderhook Group, and also the only one that bears four arms.

Found in the Kinderhook Group at LeGrand, Iowa, and now in the collection of Wm. F. E. Gurley.

AGELACRINUS PULASKIENSIS, n. sp.

Plate III, Fig. 18, a specimen showing the ovariou or anal pyramid.

Species large, body circular and with more than the usual convexity. The outer rim is composed of numerous large squamiform plates, that imbricate inward from the periphery, those near the margin being the smaller, as in all other known species in this genus. The plates of the disc within the outer rim and between the arms are large and imbricating, though a few of them appear to be very slightly imbricating. There are five very long, slender, curving arms, forming convex ridges, four of them sinistral and one dextral. The central part of the arms, so far as shown in our specimen, consists of a double row of interlocking plates, which are supported by large plates laterally, that rise nearly as high as the central plates. The central part from which the arms radiate is more convex than any other part of the body and is covered with numerous small plates. The ovarian or anal aperture is situated about the middle of the largest interbrachial area and surrounded by the dextral and one sinistral arm. It is a depressed convex, circular prominence covered with twelve cuneiform plates. The surface of the plates is finely granular.

This species has some resemblance to *Agelacrinus cincinnatiensis*, but the arms are longer, body more convex, ovarian aperture larger and covered with more large plates.

Found in the Kaskaskia Group in Pulaski County, Kentucky, and now in collection of Wm. F. E. Gurley.

FAMILY RHODOCRINIDÆ.

ARCHÆOCRINUS PECULIARIS, n. sp.

Plate II, Fig. 1, lateral view of a specimen slightly compressed laterally; Fig. 2, azygous view of same, showing the curved radial series with an azygous plate over the first radial; Fig. 3, basal view of same.

Species large. Calyx globose; greatest diameter about the top of the second primary radials and very slightly exceeding the height; constricted below the arms; plates convex and free from radial ridges; sutures beveled; surface granular.

Basals small, deep within the calyx and covered by the column. Subradials longer than wide and truncated at the superior ends by the first interradials. The inferior ends curve abruptly into the columnar cavity and are notched so as to give a subpentagonal outline to the columnar cavity, which indicates that the column (which is unknown) is pentagonal. These plates curve gently upward so that the calyx will rest below the middle and show half the length in a side view.

Four of the first primary radials are pentagonal, about equal in size, and about as wide as high. The other one is hexagonal, has unequal sides and is the largest plate in the calyx. It is on the left of the azygous area and supports on its upper side an azygous plate and upon the left superior lateral side the second primary radial, as shown in the illustration.

Four of the second primary radials are hexagonal, about the same size as the four first primary radials and nearly as high as wide. The other one is pentagonal, somewhat smaller and inclined so as to present a horizontal upper face for the support of the third primary radial, as shown in figure 2.

Third primary radials very little more than half as large as the second, smaller than the adjoining interradials, of about equal size, about as wide as high, pentagonal, and support on each upper sloping side a single secondary radial. Secondary radials a little more than half as large as the third primary radials, hexagonal and support upon the inner upper sloping sides a secondary interradial, and upon the superior faces a single tertiary radial, and upon the outer upper sloping sides two tertiary radials (?). Our specimen is not preserved beyond these plates. There are, therefore, twenty (?) arms arising from the calyx.

There are eight plates in each regular interradial area. The first ones are the largest plates in the calyx, excepting, only, one of the first primary radials. They are heptagonal, longer than wide, truncate the subradials and extend nearly as high as the second primary radials. There are two plates in the second range equal in size, and larger than the third primary radials. These are followed by three much smaller and somewhat elongated plates in the third range, and these, in turn, are followed by one plate in the fourth range, which reaches as high as the tertiary (?) radials above described, and which, we suppose unites with the plates of the vault, as we suppose the single secondary interradials did. No part of the plates of the vault is preserved, in our specimen, neither are any of the arm openings to the vault, and it is, therefore, probable that the plates which we have called tertiary radials on the outer upper sloping sides of the secondary radials are interradials, and, if so, only ten arms arise from the calyx, which are separated by wide interradial areas connecting with the vault.

The azygous interradial area differs from the regular interradial areas chiefly in the fact that it contains an additional, large plate, in the second range, which occupies the usual position of a second primary radial. Take out this long heptagonal plate and close up the space by straightening the crooked primary radial series and then all the interradial areas will be substantially alike.

The absence of radial ridges, general form of the calyx, number of interradials and peculiar position of the large heptagonal plate in the second range of azygous interradials will distinguish this species from all others hitherto described. Walter R. Billings figured and described three plates, in the second range, in the azygous area, of *Archæocrinus desideratus,* but the additional plate is like other plates, in the second range of the interradial areas, and did not disturb the adjacent primary radial series. We do not consider the absence of radial ridges or peculiar position of the azygous plate as of more than specific importance and hence have no hesitation in referring this species to the genus *Archæocrinus.*

Found in the Trenton Group in Knox County, Tennessee, and now in the collection of Wm. F. E. Gurley.

ARCHÆOCRINUS ASPERATUS, n. sp.

Plate II, Fig. 7, basal view, azygous side below; Fig. 8, summit view, azygous side below and matrix covering some of the plates on the right; Fig. 9, azygous side view.

Species medium size. Calyx bowl-shaped, subpentagonal in outline, more than twice as wide as high; radial ridges interrupted at the sutures; plates subspinous or very convex and more or less sculptured; surface granular; columnar cavity wide, deep, and sculptured so as to indicate a pentagonal column.

Basals small, deep within the calyx, but not covered by the column, in fact, the column enters the cone formed by the basals leaving the basals abutting the subradials outside the circumference of the column. Subradials large, longer than wide, abruptly bent into the columnar cavity and upward between the radials, leaving a transverse ridge across the middle part of each, from each end of which a radial ridge arises, that unites with another in the central part of each first primary radial. The calyx will rest upon these ridges as the sculpturing is deep. The azygous subradial is octagonal the others are heptagonal, the shorter sides abut upon the basals and adjacent subradials, the longer sides support the radial series while each is rather broadly truncated at the superior end.

Three of the first primary radials are pentagonal, the other two, on the right of the azygous area, are hexagonal. They are all wider than high, the shorter sides abut the interradials, the longer sides the subradials and second radials. The superior side that abuts the second radial is arcuate externally. The inferior angle of each is sunk in a deep pit, the central part of the plate is convex from which a radial ridge extends to each adjacent subradial, while the greatest prominence exists in the upper part.

Four of the second primary radials are hexagonal and one pentagonal, they are of unequal size and vary from a little wider than long to more than twice as wide as long. All of them are longitudinally convex in the central part and bear central nodes. The third primary radials are smaller than the second, of unequal size, pentagonal, axillary, and support upon each upper sloping side two small, short, secondary radials before reaching the free arms. The second and third primary radials together are not larger than the first. The radial ridge in each series continues across the secondary radials and unites with the convex outer surface of the arms. There are ten arm openings to the vault. There is a single small intersecondary plate, in each area, that is followed by a larger and longer plate, which separates the bases of the arms and unites with the plates of the vault.

The first interradials are the largest plates in the calyx, they are subpyramidal and terminate in an acute, central point. They broadly truncate the subradials, separate the primary radials, in in some areas, and, in others, both the primary and secondary radials, and are each followed by five or six plates, in the form of a yoke or arch, that reaches down half or more than half the length of the first interradial. They have, therefore, eight, nine or ten sides, depending on whether or not they abut the second primary radials, and whether there are five or six plates in the yoke. The three or four superior plates of this arch separate the secondary radials and are followed by three or four plates that separate the bases of the arms and unite with the plates of the vault. The number of plates in the regular interradial areas are, therefore, not quite uniform, and they graduate into the plates of the vault so as to leave no distinct line of separation.

In the azygous interradial area two plates truncate the subradial, one large, the other small. The large plate corresponds with the first plate, in the regular areas, and has only eight sides, one of which rests on a subradial, another against a first primary radial, another against a second primary radial, and the others against five plates, that form a yoke, as in the other areas, except one side of it reaches a subradial and separates the large plate entirely from one radial series. The area is wider than the regular areas and the plates are somewhat larger, but not more numerous. The superior plate in the yoke extends a little higher than the plates in the regular areas, it unites with plates, at the bases of the arms, and others that extend to the vault, as in the other areas, though not exactly in the same order of arrangement.

The vault is elevated over the arm furrows, convex on the azygous side of the proboscis, but somewhat flattened on the other side. The proboscis is subcentral. The vault is covered by numerous polygonal, highly convex plates and is moderately depressed toward the interradial areas. The proboscis is broken off, but so far as preserved, it is small, round and composed of small, highly convex plates.

This species is probably as nearly related to *Archæocrinu sculptus*, which we suppose was collected in the same group of rocks, as to any other, but the structural differences are so marked that no comparison is necessary.

Found in the Trenton Group, in Knox County, Tennessee, and now in the collection of Wm. F. E. Gurley.

ARCHÆOCRINUS PARVUS, n. sp.

Plate II. Fig. 26, basal view; Fig. 27, azygous side view; Fig. 28, summit view.

Species small; calyx saucer-shaped subpentagonal in outline, more than twice as wide as high; radial ridges not distinguished and interrupted at the sutures; plates sculptured; surface granular; columnar cavity of moderate depth and indicating by its shape a pentagonal column.

Basals sunk within the calyx and showing a pentagonal outline beyond the circumference of the column. Subradials longer than wide, sharply bent into the columnar cavity and upward between the radials, leaving a pentagonal cavity below bounded by a sharp, angular ridge, upon which the calyx may rest, showing the subradials in a side view.

First primary radials sculptured, wider than higher, pentagonal. Second radials twice as wide as high, hexagonal. Third radials short, pentagonal, axillary, and supporting upon each upper sloping side the secondary radials. No tertiary radials. Ten arm openings to the vault.

First regular interradial large, sculptured and supporting two plates in the second range that separate the secondary radials and unite with the plates of the vault. First azygous interradial large and supporting in the second range three plates, the lateral ones small; these are succeeded by three plates that unite with the plates of the vault, the lateral ones uniting with the protecting sides of the ambulacral furrows.

Vault moderately convex and covered with polygonal convex plates, proboscis small and subcentral.

This species, though small and somewhat resembling *A. asperatus*, is so distinct as to require no comparison to distinguish it.

Found in the Trenton Group, in Knox County, Tennessee, and now in the collection of Wm. F. E. Gurley.

FAMILY MITROCRINIDÆ, n. fam.

MITROCRINUS, n. gen.

[Ety *mitra* a turban; *krinon* lily.]

Calyx depressed; vault elevated. Basals three, equal. Primary radials three by six. Secondary radials. No subradials. Regular interradials three. Azygous interradials three or more, the first one resting on a single basal.

The peculiarities in this genus are the six radial series instead of five, and the resting of the first azygous plate on a single basal instead of on two basals. Beside this genus is from the Trenton Group and is the only one having three equal basals, thus far known, from the Trenton rocks of America. Type M. *Wetherbyi.*

This genus cannot be referred to any of the described families, if any regard is paid to the structure of the calices. The specimen is quite complete, on which the genus is established. It is symmetrical in all its parts, and a line drawn through the center of the azygous area will cut it in two equal parts, leaving three radial series upon each. The three basal plates are almost absolutely equal, notwithstanding one of them supports an azygous plate. The vault is as perfect as that of any other crinoid and has a resemblance to that of a *Dorycrinus.* Under the circumstances we propose the new family name *Mitrocrinidœ* and ascribe to it the following characters: Basals three. Primary radials three by six. No subradials. Regular interradials. Whether other characters ascribed to the genus will be found to be of family value will depend upon future discovery of allied genera.

MITROCRINUS WETHERBYI, n. sp.

Plate II, Fig. 4, azygous view, the central spine may be seen beyond the azygous opening and two of the subspinous plates on the sides, but the plates of the azygous side are small and sutures too obscure for correct illustration; Fig. 5, basal view, azygous side above; Fig. 6, Summit view.

Calyx depressed, radial elevations distinct, but not specialized as ridges; interradial areas concave; sutures slightly beveled; surface granular; height less than half that of the vault; arm openings directed horizontally.

Basals three, exposing externally a large heptagonal disc, the side on which the azygous plate rests being short and truncation slight. In the center there is a concave depression for the insertion of the head of the column which is surrounded by a pentagonal rim, too delicate for illustration, that indicates the column is pentagonal. First primary radials a little wider than long, superior face a little concave, three hexagonal and three heptagonal. Second radials more than twice as wide as long, hexagonal. Third radials twice as wide as long, pentagonal, axillary and bearing upon each superior sloping side secondary radials, giving to the species twelve arms.

There are three regular interradials in each area. The first hexagonal, longer than wide and succeeded by two plates in the second range, each of which is as large as the first one. These unite with the plates of the vault and those covering the ambulacral grooves. There is no boundary line between the plates of the calyx and vault as they graduate into each other in the interradial areas and the ambulacral coverings. First azygous plate pentagonal, rests on a single basal, and longer than wide; two plates in the second range which reach as high as the calyx proper and unite with the plates of the vault and ambulacral coverings. The azygous area is nearly perpendicular from the top of the first azygous plate to the summit of the vault, and, above the second range of plates, is covered by numerous smaller ones.

Vault ventricose, radial areas high. The larger plate occupies the summit and bears a short central spine or conical elevation. It is surrounded by eight plates, which are next in size, on the vault, all of which are convex and some of them somewhat conical. The other plates on the vault, including those on the radial and interradial areas, are polygonal, convex and granular. The azygous opening is separated from the central plate by three of the eight plates above described, as surrounding the central plate. It is broken, in our specimen, but does not appear to have extended higher than the central plate.

The specific name is in honor of Prof. A. G. Wetherby, to whose skill and untiring energy is due the discovery of this and the three preceding species as well as the locality from which they were obtained.

Found in the Trenton Group, in Knox county, Tennessee, and now in the collection of Wm. F. E. Gurley.

FAMILY POROCRINIDÆ, n. fam.

This family has five basals; five subradials; one by five radials; no regular interradials; small arms; and deep pits and pectinated rhombs, at the angles of the plates. It resembles, in its general structure, the *Cyathocrinidæ*, and *Poteriocrinidæ*, but the azygous area is not like that of any other known genus and the pectinated rhombs are like those belonging to *Cystideans*.

POROCRINUS KENTUCKIENSIS, n. sp.

Plate II, Fig. 19, side view showing deep pits or pectinated rhombs and part of the arms, azygous side on the right.

Calyx obpyramidal, pentagonal, in outline, with the angles at the center of the subradials and again at the arm bases. Height equal to the greatest diameter. Surface radiately sculptured from the center of each plate to the center of each adjoining one. The base of our specimen is slightly broken away so that the true length of the basal plates is not shown in the illustration. The subradials are the largest plates in the calyx and occupy more than one-third of the length. The first radials are next in size and a single, small, round arm, occupying about one-third the width, arises from the superior central part. Only three short plates in three of the arms are preserved in our specimen, but the ambulacral furrows may be seen extending to the central part of the vault. The third plate is not axillary and hence the arms do not bifurcate on that plate if at all. There are two azygous interradials that seem to be arranged as in the type of the genus, but our specimen is silicified and the sutures are very indistinct. The vault is quite convex in this species. There is a very large pectinated rhomb at each angle of every plate in the calyx and smaller ones on the vault. Twenty-eight can be distinguished in our specimen.

The general form, surface ornamentation and exceedingly large pectinated rhombs at once distinguish this species.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY CYATHOCRINIDÆ.

CARABOCRINUS OVALIS, n. sp.

Plate II, Fig. 20, azygous side view; Fig. 21, opposite view.

Our specimens are silicified and part of the plates in the arms do not show the sutures. Calyx suboval in outline, the smaller end below, which is narrowly rounded, and the scar for the attachment of the column very small. Surface destroyed in silicification. Basal plates small. Subradials the largest plates in the calyx, wider than high and evenly rounded. The radials are the next in size, very evenly rounded and slightly truncated about one-third the width in the superior central part for the free arms. The arms are small and round and bifurcate on the second plate. They bifurcate again on the third or fourth plate, the silicification destroying the sutures. And one of the arms in every ray bifurcates again, making thirty arms in this species. The arms cluster together over the vault and are so interlaced that more divisions of the arms may take place which are not disclosed by either of the two specimens before us. The azygous plates are arranged as in *Carabocrinus radiatus*, but the first plate which truncates a basal plate is regularly hexagonal and about as wide as high, and thus differs in form from *C. radiatus*. The second plate is smaller and truncates a subradial. The third plate is fully as large as the first and longer than wide.

The general outline of the calyx in this species is much like *Carabocrinus vancortlandti*, but the arms are quite different, as the first bifurcation, in that species, takes place on the third plate, while in this one, it takes place on the second plate. The general form of the calyx is altogether different from that in *C. radiatus*, but the first bifurcation takes place on the second plate in the free arms, in both species, though above that the arms are altogether different.

Found in the Trenton Group, in Mercer County, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY GAUROCRINIDÆ.

RETIOCRINUS ALVEOLATUS, n. sp.

Plate II, Fig. 22, azygous view.

Column comparatively large and pentagonal. Calyx pentagonal, transversly. Basals extend but little beyond the column, deeply sunken or bearing a pit at each lower lateral side and a convex ridge directed to each adjacent subradial. Subradials longer than wide, the superior angle reaching almost as high as the first radials, and bearing four radiating rounded ridges, two of which unite with the basals below, and the others with the adjacent first radials. There is a large deep pit at each lateral angle. These pits in the calyx look like the pits or pectinated rhombs in *Porocrinus*. Our specimen is silicified, and the depth of these pits or whether or not they pass to the inside of the calyx cannot be accurately determined. The subradial on the azygous side bears an additional ridge that extends upward to the large plates in the middle of the azygous area.

There are four primary radials in each series, rounded externally and, at first view, looking like free arms, but there are small plates upon each side of the ambulacral furrow that unite with a central balloon-shaped body exposing the small plates in the interradial areas. There are four secondary radials in each series and they are connected, internally, with the central part of the body just as the primary radials are. The arms then appear to become free and each one bifurcates again from the fourth to the ninth plate, as near as the plates can be counted in our specimen. Thus giving to the species forty arms. In the azygous area there is a central row of large plates, looking like an arm, that extends as high as the secondary radials, and is connected with the central balloon-shaped body just as the primary and secondary radials are, except, of course, there is no ambulacral furrow, but a furrow nevertheless. The appearance of our specimen indicates the continuance of the balloon-shaped body, in the form of a proboscis, probably to the height of the arms, but there may be some doubt about it, as the arms are so numerous and so closely crowded together, that it cannot be clearly distinguished.

Billings described the genus *Retiocrinus* as follows: "This remarkable genus has no perfectly formed plates. The cup consists of a reticulated skeleton, composed of rudimentary plates, each consisting of a central nucleus, from which radiate from three to five stout processes. Of such plates there are five in the basal series, five in the subradial, and five in the radial series. On the azygous side the subradial has five processes; the others have four each."

The general appearance of the genus is that of a reticulated skeleton, as Billings described it, but the plates are all perfectly formed and not by any means rudimentary. The interradial areas are abruptly sunken, and, as shown in our specimen, small plates connect the inner sides of the radials, with a central body, that is also covered with very small plates, which, if not so deeply depressed, would look somewhat like the interradial areas in *Gaurocrinus*, and if they were not depressed, at all, they would look like the interradial areas of *Glyptocrinus*, except they are covered with smaller plates. The ambulacral furrows in *Glyptocrinus* and *Gaurocrinus* enter the top of the calyx and unite centrally immediately below the vault, while in this genus they appear to follow down the radial series and to unite, at the lower part of the calyx, or between the subradials. The structure indicates this, but the channels forming the union have not been discovered. We have called this central cavity a balloon-shaped body, only for the purposes of description, for it is the same as the cavity of the calyx in other genera. Its form is only more balloon-shaped than an ordinary calyx because it is small in the lower half of the calyx. Even if the ambulacral furrows unite at the summit of the calyx, and not below, as we have thought most probable, the other structural parts are sufficient to warrant the generic name. No comparison of this species with any other is necessary to distinguish it, but it is interesting to note the finding of a new species in this rare genus, several hundred miles distant from the typical locality.

Found in the Trenton Group, in Mercer County, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY GLYPTOCRINIDÆ.

GLYPTOCRINUS MERCERENSIS, n. sp.

Plate II, Fig. 23, azygous side view.

General form of the calyx, somewhat obpyramidal, transverse section pentagonal. Radial ridges prominent, plates deeply sculptured with stellate ornamentation. Interradial areas flattened. Column round and medium size.

There are five sculptured basal plates that extend in the form of a sharp ring below the top of the column. They are a little wider than high. The first primary radials are heptagonal, rather wider than high. The second primary radials are hexagonal, longer than wide and about two-thirds as large as the first. The third primary radials are heptagonal, abut upon two interradials, at each side, wider than high, about two-thirds as large as the second, axillary, and bear upon the superior sloping sides the secondary radials. There are three or four secondary radials in each series that enter into and form part of the calyx and then the radial ridge becomes more prominent and the arms become free. There are no tertiary radials and no divisions of the arms. There are, therefore, only ten arms in this species. The plates of the arms are short and the pinnules very dense.

The regular interradial areas have one large plate in each, resting upon the upper sloping sides of the first primary radials and separating the second primary radials. It is followed by two plates in the second range and above this the number cannot be ascertained from our specimens. In the azygous interradial area there is one large plate resting upon two first primary radials, which is followed by three plates in the second range, and above these the number of plates can not be determined in our specimens. A ridge arises at the center of the first azygous plate and extends straight up the center of the azygous area, a distance beyond the commencement of the free arms, and to the top of a proboscis. This species possesses a vault altogether different from that belonging to *G. decadactylus*, and it also possesses a proboscis or extension of the vault which has not been heretofore known to belong to any species of *Glyptocrinus*. In the region of the first and second radials and first interradials, it resembles *G. decadactylus*, but is quite different in all other parts, beside having only ten arms. It can not be mistaken for any other described species.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY CALCEOCRINIDÆ.

CALCEOCRINUS KENTUCKIENSIS, n. sp.

Plate II, Fig. 24, anterior side view; Fig. 25, posterior side, showing place of attachment of the column of same specimen.

From the cicatrix for the attachment of the column, we infer, that the body hung close to the column; the column is small and round. We have two specimens, about equally well preserved, both are silicified, but show the sutures correctly, unless it may be in the basal plate. The basal plate is triangular and, as shown by the sutures, composed of four anchylosed plates, though the sutures are obscure. The columnar facet is at the posterior angle. There is a wide gaping suture between the basals and the radials on the anterior side, that is somewhat denticulated on the anterior margin. Following this gaping suture on the anterior side there are three radials, in the first transverse series; the middle one is twice as long as wide, quadrangular, and constricted in the middle; the outer ones are hexagonal, about twice as wide and about twice as large as the middle one. The second transverse series commences in the middle part with a short wide plate that rests upon the superior side of the middle plate in the first series, and upon the inner sloping sides of the two lateral plates, in the first series. It is about three times as wide as long and is succeeded by a plate, that contracts rapidly upward, somewhat in the form of the frustum of a cone. It has a length about equal to the shorter width. This last plate bears a free single arm composed of rather long round joints. The superior lateral side of each of the lateral plates in the first series bears two brachial plates, the second one of which is axillary and bears free arms. Every second or third plate in the free arms is axillary, though one of the rays thrown off from each axillary plate is smaller than the main arm and does not bifurcate again.

Turning now to the posterior side, we find on the right a small intercalated triangular plate, and a brachial series of three plates resting upon the right side of the triangular basal and this intercalated triangular plate. This brachial series reaches about as high as the other brachial series, the last plate is axillary and bears free arms. Every second or third plate in these free arms is axillary, though one of the rays thrown off from each axillary plate is smaller than the main arm and does not bifurcate again. On the left of the posterior side we also find a small intercalated triangular plate, and a longitudinal azygous series resting on the left side of the triangular basal and this intercalated triangular plate. The azygous series consists of three large round plates, having a width more than twice as great as their length, and they are followed by a long round proboscis that extends beyond the limit of our broken specimens and probably beyond the length of the arms. The three azygous plates reach about as high as the brachials above described and in comparing with other crinoids this would be the limit of the calyx, and above this are the free arms and long proboscis. It will be understood that we have described this species as if it were standing up instead of hanging down from the end of the column.

It is unnecessary to compare this species with any others that have been described, though it is doubtless congeneric with the species described by W. R. Billings, and for which Ringueberg has described a genus under the name of *Castocrinus*. Probably, without hesitation it should be called *Castocrinus kentuckiensis*. But there has been so much blundering and bad work done with the *Calceocrinidae* and so many synonyms proposed, that we have thought, without taking the time now to review the subject, it would be sufficient to provisionally refer it to *Calceocrinus*, though we think, at present, that *Castocrinus* will be retained for this generic division of the family.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY POTERIOCRINIDÆ.

POTERIOCRINUS CIRCUMTEXTUS, n. sp.

Plate II, Fig. 29, azygous side, showing the interlacing arms and proboscis; Fig. 30, opposite side of same specimen.

Species medium size, with a remarkably large proboscus. Calyx cup-like, or somewhat obconoidal; truncated below for a moderately large column; wider than high; sutures distinct; surface smooth or very finely granular.

Basals one-fourth wider than high, pentagonal, gradually expanding. Subradials about as long as wide, three hexagonal and two heptagonal; those adjoining the azygous area are heptagonal. First radials of unequal size, but about twice as wide as high, protuberant and rounded to the first brachials; hexagonal; the articulating scars occupy rather more than half the diameter of the plates and are directed outward and upward at an angle of about seventy degrees; a slightly gaping suture separates the first radials from the first brachials, and the superior faces of the first radials unite with the small plates that cover the vault.

There are four brachials in each of the latteral rays and three in each of the other three rays; they are short, rounded, and the last one supports upon each of its upper sloping sides free arms. All of the arms again bifurcate on the fourth plate, except one, and it bifurcates on the fifth plate. Every arm bifurcates again on plates ranging from the sixth to the sixteenth. At this height there are forty arms; some of them are seen to bifurcate again in our specimen, and probably all bifurcate again, making eighty arms in the species. The arms are round, plates long and sutures transverse.

The azygous area is wide and ventricose. The first plate is pentagonal, rests between the upper sloping sides of two subradials, separates the first radial on the right from the second azygous plate, and is truncated above for the third plate. The second plate is hexagonal, rather larger than the first, truncates a subradial, abuts the first radial on the left and the first and third plates on the right and supports two plates above. The third plate rests upon the first and is in line with the upper half of the second, supports two plates above and other plates on the right. The first and third plates thus described support three plates in the next range, which are succeeded by plates of the proboscis.

The proboscis is large, long, cylindrical, and covered with polygonal plates. Round pores penetrate the proboscis throughout its length at nearly every angle of the plates, and, frequently, on the sutures between the angles. The vault is covered with small plates.

This species is more nearly related to *P. subramosus* than to any other which has been described, but it is distinguished from that species by the relative proportion of the plates in the calyx, by the number and position of the azygous plates, and by the great difference in the arms, and no doubt, also, in the character of the proboscis, which is unknown in that species.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS GRANDICULUS, n. sp.

Plate II, Fig. 31, azygous view; Fig. 32, view opposite the azygous area.

Body rather large, robust and elongate-ovate in outline. Calyx very low. Columnar cavity shallow. Surface smooth or finely granular. Column very small, round and composed of thin plates.

Basal plates within the calyx. Subradials with an acute superior angle, but invisible in a lateral view. First radials about one-half wider than long, rapidly expanding to the superior lateral angles, and truncated the entire width above for the support of the second primary radials. The inferior angles do not extend into the columnar cavity. Four of them are pentagonal, but two of them are separated by the extension of an azygous plate so as to reach the point of a subradial, and the one on the right supports two azygous interradials, as well as the radial series which gives to it an heptagonal outline. Four of the second primary radials are pentagonal, one-half wider than high, axillary, and support on each upper sloping side the secondary radials; but in the ray opposite the azygous area there are three primary radials, and consequently the second is quadrangular, twice as wide as high, and supports the third, which is three times as wide as high, pentagonal, axillary, and supports upon the upper sloping sides the secondary radials.

In one of the secondary radial series there are three plates, in six of them each has four plates, in two of them each has six plates, and one of them has five plates. One ray which is opposite the azygous area, having six secondary radials, supports upon each upper sloping side tertiary radials, which continue to the end of the arms. Nine other tertiary radial series do not bifurcate, but so far as can be determined all the others bifurcate once, and one of the arms thus thrown off in each series bifurcates again, except in one ray. This gives us eight arms in each of four series, but only five arms in the ray opposite the azygous side, which possesses three primary radials, thus making thirty-seven arms in this species. But there is some injury to the specimen in two or three places, and the last bifurcation may not take place in one or two rays, and possibly, therefore, the species may have only thirty-six arms.

The azygous area commences with one plate, sending a sharp angle between the first radials to the angle of a subradial; this is succeeded by three plates in the second range, and these by three plates, and these again by two, the superior plate being the largest in the area and acutely pointed above. There are, therefore, nine azygous plates.

Found in the Kaskaskia Group, at Bowling Green, Kentucky, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS SCOPAE, Miller & Gurley.

Plate III, Fig. 1, lateral view magnified two diameters; Fig. 2, lateral view of same specimen natural size, azygous area on the left.

When the authors described this species in 1890 in their "Description of some new genera and species of Echinodermata from the Coal Measures and Subcarboniferous Rocks of Indiana, Missouri and Iowa," which work was subsequently reprinted in the 17th Report of the Geological Survey of Indiana, only the azygous side was illustrated, and, as it seemed desirable to have it further illustrated, two lateral views are here presented, one natural size and one magnified two diameters.

The specimen is from the typical locality, in the Kinderhook Group, at Le Grand, Iowa, and is in the collection of Wm. F. E. Gurley.

POTERIOCRINUS MACCABEI, n. sp.

Plate III, Fig. 3, posterior side, natural size; Fig. 4, same magnified two diameters; Fig. 5, azygous side of same specimen magnified two diameters, part of the azygous area broken away, there is on this specimen a Poteriocrinus decrepitus showing the posterior side somewhat injured; Fig, 6, same, natural size.

Species small, but bearing very long rugged or geniculated arms. Calyx obconoidal, as seen from the posterior side, but quite unsymmetrical on account of the development of the azygous area; height and greater diameter nearly equal; plates smooth. Column small, round.

Basals moderate size, in proportion to the calyx, with superior angles acute. Subradials a little wider than high, except one on the azygous side which has a length fully equal to the greater width; four of them are hexagonal, the other two are heptagonal. The azygous subradial, which is truncated at the top, is heptagonal and the largest plate in the calyx. The other heptagonal plate is on the right of the azygous area and is a little larger than either of the hexagonal plates. First radials one-third wider than high, quite convex longitudinally, which leaves the separating sutures much depressed, pentagonal and truncated the entire width above, where the sutures are slightly gaping. A single, long, rounded, brachial, supports upon the upper sloping sides, in each radial series, the free arms. These brachials are contracted in the middle part and of unequal length; the one opposite the azygous area is the longer, the two adjacent are the shorter, and the other two have an intermediate length. There are only ten arms in this species; they are long and composed of rather long, cuneiform, alternately projecting plates. Each projecting joint bears a large, tapering, long jointed pinnule, which gives to the arms a very rough or crisped aspect.

The azygous area is wide and covered with a double series of alternate plates. The first plate is pentagonal, longer than wide and rests between the superior sloping sides of two subradials and between the first radial on the right and the second azygous plate on the left and is truncated on top for the third azygous plate;

the second plate is hexagonal, larger than the first, rests upon the truncated upper end of the largest subradial and between the first radial and a summit plate on the left, and the first and third azygous plates on the right and is truncated at the upper end for the fourth plate. This alternate arrangement continues as far as the proboscis is preserved in our specimen.

This species is peculiar in its comparatively long, rough arms and wide azygous area. It need not be compared with any other described species, for *P. legrandensis* is as near to it as any other, and in that species there are twenty much shorter arms and a narrower and different azygous area.

Found in the Kinderhook Group, at Le Grand, Iowa, and now in the collection of Wm. F. E. Gurley.

It was found by John McCabe, of Quarry, Iowa, in whose honor we take pleasure in dedicating this beautiful crinoid.

POTERIOCRINUS HAMMONDI, n. sp.

Plate III, Fig. 7, azygous view, magnified two diameters; Fig. 8, same, natural size.

Species small, but bearing long slender arms, which, when closed around the proboscis as in our specimen, make the body subcylindrical. Calyx obconoidal; height and greater diameter nearly equal; plates smooth. Column rather large at the calyx, but tapering for a short distance, when it becomes of ordinary size and consists of thin, round plates.

Basals of moderate size, in proportion to the calyx, with superior angles acute. Subradials hexagonal, wider than high, the one below the azygous area is much the wider, but so broadly truncated on top as to give it little if any greater length. First radials about as high as wide, evenly rounded, pentagonal, and truncated the entire width above, where the sutures are distinct but not gaping. A single, very long, contracted and rounded brachial, supports upon the upper sloping sides, in each radial series, the free arms. The contraction of these remarkably long brachials actually constricts the body immediately above the calyx. One of the lateral brachials is shown in our specimen, and it is a little shorter than either one adjoining the azygous side of the proboscis, and we may presume the one opposite the azygous area is the longer one, as that is the case in *Poteriocrinus maccabei* and in some other species. There are only ten arms in this species;

they are long and composed of long, slightly cuneiform, alternately projecting plates. Each projecting joint bears a small pinnule, which does not prevent the arms from closing tightly around the proboscis.

The azygous area is not large in this species. There is only one plate within the calyx, and it broadly truncates a subradial and separates two first radials. There appear to be two plates succeeding this one, but the arms in our specimen prevent further examination of the plates.

This species is peculiar in its long, delicate form, closed arms, long brachials and constriction above the calyx. The axygous area is also peculiar and we know of no species with which it is necessary to make any comparison in these particulars.

Found in the Kinderhook Group, at LeGrand, Iowa, and now in the collection of Wm. F. E. Gurley. The specific name is given in honor of Mr. L. A. Hammond, an enthusiastic collector of LeGrand, Iowa.

POTERIOCRINUS MACCABEI *var.* DECREPITUS, n. sp.

Plate III, Fig, 9, azygous side of a depressed and somewhat injured specimen magnified two diameters; Fig. 11, same, naturel size; Fig. 10, posterior view two diameters; Fig. 12, same, natural size; the posterior view of another specimen, magnified and natural size, may be seen on Poteriocrinvs maccabei in Figs. 5 and 6.

This is a small species bearing short rugged arms. Calyx obconoidal as seen from the posterior side, but unsymmetrical on account of the development of the azygous area. Diameter one half more than the height; plates smooth; column small, round.

Basals small and superior angles somewhat obtuse. Subradials one-half wider than high, except the one on the azygous side, which has a length about equal to the greatest width; four of them are hexagonal, the other two are heptagonal. The azygous subradial, which is truncated at the top, is heptagonal and the largest plate in the calyx. The other heptagonal plate is on the right of the azygous area, but is not larger than the hexagonal plates. First radials, one-third wider than high, quite convex longitudinally, which leaves the separating sutures much depressed pentagonal, and truncated the entire width above, where the sutures are gaping. A single, rounded brachial supports upon the upper sloping sides in each radial series, the free arms. These brachials are contracted in the middle part and of unequal length; the one opposite the azygous area is the longer, the two adjacent are the shorter and the other two have an intermediate length. There are only ten arms in this species; they are short though composed of rather long, cuneiform, alternately projecting plates. Each projecting joint bears a large, tapering, long jointed pinnule, which gives to the arms a rough geniculated aspect.

The azygous area is covered with the same number of plates which are arranged in the same order that they occur in *P. maccabei.* The difference between the two is that in this species the area is proportionally narrower.

We have three specimens of this species which are free (and accidentally the best one is not illustrated) beside the one figured on *P. maccabei*, and they all bear the same proportions as to size of calyx and arms and size of the plates. The calyx in this species is fully as large as it is in *P. maccabei*, though slightly differing in form, the arms and pinnules are as coarse, but the arms have not more than two-thirds the length. The question then arises whether the minor differences which may be seen in the illustrations and the discriptions, coupled with the wider azygous area and longer arms in *P. maccabei*, are sufficient to distinguish species. One cannot be the young of the other unless age widened the azygous area and lengthened the arms without increasing the size of the plates, which is contrary to what we know of these animals. *P. maccabei* is graceful in its form and is not abnormal. Possibly the difference between the two should be regarded as of specific value, but we have not regarded it as of more than varietal importance.

Found in the Kinderhook Group, at LeGrand, Iowa, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS SALEMENSIS, n. sp.

Plate III, Fig. 17, lateral view, azygous area on the left.

Our specimen is on a slab and the ray opposite the azygous area is not exposed. The species is of medium size. Calyx basin-shaped below the summit of the first radials and subpentagonal in outline in the superior part, deeply concave below; sutures distinct, surface granular.

Basals form a narrow pentagonal rim almost obscured by the column. Subradials abruptly bent upward and into the basal concavity, at about the middle part, about as wide as long. The one on the right of the azygous area heptagonal and broadly truncated for the first radial, the next one to the right hexagonal. First radials twice or more than twice as wide as high, pentagonal, truncated the entire width above and separated from the second radials by a gaping suture. Second radials larger than the first, about twice as wide as high, pentagonal, prominent almost nodose at the superior angle, and supporting on each upper sloping side the secondary radials. There are six secondary radials in each arm shown by our specimen, four of them are short plates with transverse sutures, the first one is the larger one and the last is pentagonal and supports upon each of the upper sloping sides the tertiary radials. One of the arms does not again bifurcate and consists of short flattened quadrangular plates. The other arm bifurcates again on the eighth plate and the arm adjoining the azygous side again bifurcates, and so does the corresponding arm in the other ray, which gives us seven arms to each of these rays.

The first azygous plate is pentagonal, abuts upon two subradials and the first radial on the right, and supports two interradials in the second range, one of which truncates a subradial. There are two interradials in the third range, beyond which they are not shown in our specimen.

It is not necessary to compare this species with any other for the purpose of distinguishing it.

Found in the Keokuk Group, at Salem, Indiana, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS CYLINDRICUS, n. sp.

Plate III, Fig. 19, a large specimen compressed antero-posteriorly showing azygous side; Fig. 20, a smaller specimen compressed laterally showing azygous side; Fig, 21, opposite view of same.

This species is rather large and very long. The body is subcylindrical, though constricted above the calyx, slightly fusiform in the middle part, and slowly tapering above.

Calyx low, basin-shaped below the summit of the first radials, moderately concave below; plates convex; sutures distinct; surface granular. Column round and pierced by a very small, round central columnar canal.

Basals form a narrow pentagonal rim around the column about one-half wider than the diameter of the column. Subradials longer than wide, and curve into the basal concavity and upward, at about the middle part, so as to be visible in a side view. The curve into the basal concavity is abrupt and the middle part of each is depressed before uniting with the basal plates. Four are hexagonal and two heptagonal. First radials about one and a half times as wide as high, pentagonal, truncated the entire width above, and separated from the second radials by a gaping suture. Second radials smaller than the first, about twice as wide as high, pentagonal, and support upon each upper sloping side the secondary radials or free arms. There are, therefore, ten arms in this species. The arms are very long, subfusi form, and composed of a single series of short, quadrangular or slightly cuneiform plates. The pinnules are composed of subcylindrical pieces having a length equal to three diameters.

The first azygous plate is rather large, convex, pentagonal, rests between two subradials and the first radial on the right and abuts upon the second and third interradials. The second interradial truncates a subradial, is nearly as large as the first, and the succeeding plates are much smaller and alternately arranged as in other species of this genus.

This species has been confounded with *Z. maniformis*, by some collectors, but in that species the basal plates are hidden by the column, the body is shorter, and there are only nine arms, as the radial series opposite the azygous area bears only a single arm. It is still farther removed from all other species.

Found in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY PLATYCRINIDÆ.

PLATYCRINUS CORTINA, n. sp.

Plate III, Fig. 15, lateral view of calyx; Fig. 16, summit view with part of the vault, plates, grooves and pores preserved.

Species medium or rather below medium size. Calyx goblet-shaped; about as high as wide; broadly truncated below; round and slightly contracted immediately above the base, highly convex and protruberant in the region of the arm-bases, so as to give it a marked pentagonal outline when seen from above. Plates thick. Sutures distinct. Surface papillose or very coarsely granular. Column small, round and attached to the base in a radiately lined hemispherical depression. Columnar canal very small and round.

Basals form a low, round cup, with a slightly expanded sharp rim at the base. First radials about as long as wide, expanding very little above the basals, longitudinally convex, and becoming very protruberant at the articulating facets for the second radials. Articulating facets for the second radials a little more than half the width of the plates and directed outward and upward at an angle of about seventy degrees. Second radials short, axillary and notched for the ambulacral furrows.

The vault, so far as preserved in our specimen, is only slightly convex. The first radials, between the arm bases, curve slightly toward the vault. There are three plates between the arm furrows, the lateral ones form part of the ambulacral covering and the middle one is an interradial proper. There is a pit or pore at the junction of each interradial with the two first radials at the dividing suture, and there is also a pit or pore on each side of the ambulacral furrows, at the suture lines of the first radials. Whether or not any or all of these are ovarian apertures we are unable to state. The ambulacral furrows are shown in our specimen as open gutters and we suppose they were covered with small plates, such as cover arm furrows, which have not been preserved. From some fragments that occur on our specimen, that are not shown in the illustration, we are led to believe that the vault has a central orifice on the summit, possibly covered with small plates, in the same way we have supposed the ambulacral grooves to have been covered.

The external appearance of the calyx of this species somewhat resembles *P. allophylus* and *P. brittis*, but the differences are sufficient to at once distinguish it, if attention is paid to the form and to the articulating facets on the first radials. The differences are so great that no descriptive comparisons will serve any one in distinguishing them. But the vault, in this species, is wholly different from either of the above mentioned species and from that of any other known *Platycrinus*. If generic distinctions can be founded upon the vault, then this species does not properly belong to *Platycrinus* or to any other described genus. But, as we have only a fragment of the vault, we would not be justified in founding a genus upon it. We are convinced, that it properly belongs to the family *Platycrinidæ* and is nearer, in structure, to *Platycrinus* than to any other described genus, and hence, provisionally, refer it to that genus.

Found by the veteran collector and learned geologist, R. A. Blair, of Sedalia, Missouri, in the Choteau limestone of that locality, and now in the collection of S. A. Miller.

BARYCRINUS EXPANSUS, n. sp.

Plate IV, Fig. 2, view of the calyx, azygous side below.

Species very large, robust. Calyx more than twice as wide as high; plates very thick, highly convex; sutures distinct, sunken at the angles. Column large, pentagonal.

Basal plates comparatively small, less than one-fourth as large as the subradials, wider than high, and forming a very shallow, pentagonal, saucer-shaped cup. Subradials four or five times as large as the basals, a little wider than long, nearly equal in size, four hexagonal and one, on the azygous side, which is very broadly truncated for the azygous plate, heptagonal. First radials larger than the subradials, about three times as wide as high, nearly equal in size, remarkably thick, and truncated a little more than half the width for the reception of the second radials. The ambulacral notch very small, and facet for the second radials nearly perpendicular or having an inclination of not more than ten degrees. Azygous plate quadrangular, wider than high and a little more than half as large as a subradial.

Comparing this species with *Barycrinus magnificus,* it will be found to be proportionally much more expanded, and consequently the first radials are much wider in proportion to their length, and the facets for the second radials are larger and face nearer horizontally. The plates, too, are much more convex and deeper sunk at the angles, and in these respects, it has some resemblance to *B. herculeus.* It cannot be mistaken for either of those species nor for any other hitherto described.

Found in the Keokuk Group, in Tennessee, and now in the collection of Wm. F. E. Gurley.

FAMILY SYNBATHOCRINIDÆ.

SYNBATHOCRINUS ANGULARIS, n. sp.

Plate IV. Fig. 3, lateral view showing the greater diameter; Fig. 4, azygous side view.

Species below medium size. Plates angular. Arms very much constricted at the top of the second radials. Our specimen appears to be in its normal shape, but the calyx and arms are compressed laterally, so the diameter is nearly twice as great one way as the other, while the column is perfectly round and composed of rather long plates. Surface of all the plates granular.

The basals have a pentagonal form externally, the two shorter sides being the anterior and posterior ones, the longer side being the right lateral one when facing the azygous area, and the other two being the left lateral ones. This gives to the little cup, formed by the basal plates, a greater diameter antero-posteriorly than laterally and shows the calyx is in its normal condition, and not flattened by pressure. First radials of unequal width, and each one longer than wide. Each one is beveled from the central part toward the sutures, which makes each one subpyramidal. They are truncated the entire width above for the second radials, and in addition to both plates being beveled to the suture, the suture is slightly gaping. The second plates are rather longer than wide, quadrangular, taper a little upward to meet the constriction of the arms at the commencement of the third plate, or, in other words, the dip in toward the constriction. They, and all the other plates of the arms are beveled laterally to the sutures so that the central part of each arm is one continuous angular ridge. While the calyx does not appear to be pressed out of shape, the arms are pressed together a little, so as to make them thinner, laterally, than they should be. The plates preserved in our specimen are longer than wide. The first azygous plate is more than twice as long as wide, rests in a notch between two first radials, truncating the one on the right more than the one on the left, and extends nearly to the top of the second radials. It is followed by two plates, the larger one extending down, on one side, one third the length of the plate, and the smaller one truncating the upper side. These two plates are followed by a triangular plate that reaches nearly to the top of the third radials.

The peculiar, flattened calyx, subpyramidal, angular and beveled plates and arrangement of the azygous plates distinguish this from all other described species.

Found in the Keokuk Group, at Button Mould Knob, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY ICHTHYOCRINIDÆ.

ICHTHYOCRINUS CLARKENSIS, n. sp.

Plate IV, Fig. 5, lateral view of a compressed specimen.

Species small. Our specimen is compressed, but the general form with the arms folded is subovate. The plates are free from spines and nodes; the sutures are very distinct and slightly arcuate, the superior plates generally overlap the inferior ones in the middle part. The column is very large and entirely covers the basals and subradials so they have not been observed. There are no interradials.

There are three primary radials in each series. They widen rapidly and are subequal in length. The different series interlock instead of having a straight separating suture. There are four secondary radials in each series of about the same length, and each plate has about the same length as a primary radial, they expand very little, so that the fourth or axillary plate is not much wider than the first plate. The different series interlock in the same manner that the primary series do. The fourth plate supports upon each upper sloping side a single non-bifurcating arm, which gives to the species twenty arms. The arms are composed of short quadrangular plates, with arcuate sutures. There are twelve plates, in some of the arms, on our specimen, and if complete there would probably be as many more.

This species cannot be confounded, with any other, from rocks of the same age, nor, indeed, with any hitherto described.

Found in the Keokuk or Warsaw Group, in Clark county, Indiana, and now in the collection of Wm. F. E. Gurley.

ICHTHYOCRINUS SPINOSULUS, n. sp.

Plate V, Fig. 4, view of a compressed specimen, with part of the spines on the first radials broken off.

Our specimen is compressed, but the true form with the arms folded is roughly ovoid. Distinct sutures separate the plates. All axillary plates bear a central spine and there are occasional spines on other plates. The entire surface is papillose or very strongly granular. The column is large, round, tapers rapidly from the body and is composed of thin plates. The basals and subradials are entirely covered by the head of the column and have not, therefore, been observed. There are no interradials.

Primary radials, three in each series; they gradually widen, but are not of exactly the same length and hence there is a slight interlocking of plates, instead of straight sutures separating the different series. The first primary radials are rather longer than either of the others and each bears a remarkably strong spine, that is directed downward, by the side of the column. The second primary radials are arcuate in the middle of the upper face for the projection of a lip or flange from the third plates and each bears three small spines, one central and one on each side. The third primary radials have steep superior sloping sides, each bears a strong central knob or short spine, and two small spines, one on each side. They are axillary and bear on each upper sloping side three secondary radials.

The first and second secondary radials are of about the same size, arcuate, and are produced transversely in a sharply convex central ridge with three obscure nodes on each. The third secondary radials are larger and longer and each bears a very strong central node or obtuse spine, and supports upon each upper sloping side a single arm or tertiary series. There are, therefore, twenty arms in this species. Each arm is composed of a single series of plates united by arcuate instead of transverse sutures. The arms are infolded and broken at the superior end of our specimen, but as many as thirty plates may be counted in a single arm. Some of the arm plates bear a central spine or node, but there is not uniformity in the different arms in this respect.

This species is remarkable for its spines, nodes, and rough, uneven, external surface, and is distinguished, by its structure and the number of plates in the primary and secondary series, from all other species.

It was found in Clark county, Indiana, in what is called the Knobstone, but which we think must be of the age of the Keokuk Group, and is now in the collection of Wm. F. E. Gurley.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS AMPLUS, n. sp.

Plate IV, Fig. 6, basal view; Fig. 7, side view; Fig. 8, summit view.

Calyx large, subcylindrical or bowl-shaped, concave below. All the plates are ventricose or subspinous and radiately furrowed toward the margins. Our specimen is injured at the point of the columnar attachment and part of the radial plates are destroyed.

Basal plates not observed. First primary radials probably as wide or wider than long. Second primary radials quadrangular, a little wider than long. The calyx will rest on these plates and the first interradials. Third primary radials larger than the second, wider than high, pentagonal and bear upon each upper slopiing side a single secondary radial. The secondary radials are axillary and bear upon each upper sloping side four or five tertiary radials. There are, therefore, four arms in each series or twenty arm openings to the vault.

The first interradials are the largest plates in the calyx. Four of them have nine sides each, while the azygous plate has eleven sides. In the regular areas the first plate separates the primary and secondary radials and is broadly truncated on top for a second plate that separates the secondary and first tertiary radials and is slightly truncated on top by a small plate in the third range, and this is followed by two small plates in the fourth range which connect with small plates that separate the arms and unite with the plates of the vault. The difference between the azygous area and the other areas is very slight and consists in the fact, that the first plate abuts against the first tertiary radials and that the second plate is followed by two plates in the third range instead of one.

The vault is convex, slightly depressed in the interradial areas and apparently bears a subcentral proboscis. The plates are anchylosed in our specimen, and show none of the sutures, and, possibly the hole, which we suppose indicates a proboscis, may be only a hole broken into the vault. There are two orifices between each of the arms that penetrate the vault horizontally. They appear to be excurrent and are of the same character as those in *D. grandis, D. lacus, D. marshi, D. stellifer and D. approximatus.*

This species is so distinct from all others that have been described, that no comparison with any of them is necessary.

Found in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY ACTINOCRINIDÆ.

ACTINOCRINUS MONTICULIFERUS, n. sp.

Plate IV, Fig. 1, view of calyx azygous side on the right.

This is a remarkably large and robust species, the plates are thick and each one bears a more or less ventricose central node, and the larger plates are radiately sculptured toward the margins. The interradial areas are depressed, giving to the calyx a pentagonal outline.

Basals truncated below so as to have a diameter at the base, equal to about twice the height, they stand upright and are strongly beveled toward the lateral sutures. The middle part of the base has a hemispherical depression for the insertion of the column, leaving a wide flattened rim around the head of the column. First primary radials much smaller than the basals, longer than wide, three hexagonal and two heptagonal. Second primary radials wider than high, hexagonal and less than half as large as the first. Third primary radials in some of the rays hexagonal, larger than the second, wider than high and support on the superior sloping sides the secondary radials. There is a single secondary radial in each series, somewhat smaller than the third primary, wider than high, some heptagonal and others hexagonal, and each supports upon the superior sloping sides the tertiary radials. In the ray on the left of the azygous area there are three tertiary radials in each literal series and two in each of the proximal series, the second of which are axillary and bear upon the superior sides quaternary radials, and thus there are six arm openings to the vault in this ray. If the rays are uniform in this respect there are thirty arms in this species. Three of them are evidently alike in this regard, and we have no reason to think the other two are different, but they are so injured in our specimen that it cannot be definitely determined.

There are two small intertertiary radials, one following the other in each ray. There are eight plates in each regular interradial area, the first one is hexagonal, larger than a second primary radial, and it is followed by two plates in the second series, three in the third and two in the fourth which connect through a sharply depressed sunken area with the plates of the vault. There are eleven plates in the azygous area, the first one is rather larger than a first primary radial and in line with them, it is followed by two plates in the second series, three in the third, three in the fourth and two in the fifth, which connect in a sharply depressed area with the plates of the vault.

The vault is covered with large polygonal plates, each one of which is possessed of a remarkably large ventricose central node. It is sharply depressed toward the interradial areas and bears a large subcentral proboscis, which is broken off in our specimen at the summit of the vault.

This species is distinguished by its great size, the number of arms, the number and position of the plates in the interradial and azygous areas and the ventricose nodes on the surface.

Found in the Keokuk Group in Tennessee, and now in the collection of Wm. F. E. Gurley.

ALLOPROSALLOCRINUS CELSUS, n. sp.

Plate IV, Fig. 9, view opposite azygous area; Fig. 10, azygous view of same; Fig. 11, basal view of same specimen.

This species has a vault considerably higher than its greatest diameter, and most ventricose opposite the azygous side. The calyx is convex, at the basals, flat over the radial areas and moderately depressed in the interradial areas. The plates are all nodose or subspinous. The column is round, radiately furrowed and pierced by a large cinque foil columnar canal.

The basals are of equal size, have an hexagonal outline and form, a nodose rim around the end of the column. First radials bear a high, transverse, sharp node. Second radials, short, wide, quadrangular. Third radials pentagonal, small; three of them bear upon each of the upper sloping sides, three secondary radials giving two arms to each of the three rays. The other two rays adjoin the azygous area and the most distant sloping sides of the third radials bear three secondary radials and the proximal sloping sides bear a tertiary radial which is axillary and bears upon each of the upper sloping sides three tertiary radials, which gives to each of these rays three arms. There are, therefore, twelve arms in this species and twelve ambulacral openings to the vault.

The first regular interradials rest between the upper sloping sides of the first radials and separate the second and third primary and first secondary radials. Each of these plates bears a very large node and is followed by a single plate which in turn is followed by two plates that connect with the plates of the vault. The first azygous plate is in line with the first radials and is followed by three plates in the second range, two in the third range and two in the fourth range that connect with the plates of the vault.

The vault is somewhat conoidal, remarkably large, and covered with convex, tumid and subspinous plates.

Found in the Warsaw Group, in Tennessee, and now in the collection of Wm. F. E. Gurley.

DORYCRINUS GREENEI, n. sp.

Plate V, Fig. 1, basal view; Fig. 2, azygous side view, injured in the region of the opening; Fig. 3, summit view, showing the broken bulb over the azygous side and part of the plates over two rays.

Species large and robust. Calyx rudely pentagonal in outline, by reason of the elevated radial ridges; broadly truncated below for the attachment of a large column; breadth two and a half times as much as the height to the base of the arms; plates very thick and more or less convex; radial ridges, increasing in convexity as far the third primary radials, the upper parts of which are directed nearly horizontally; sutures beveled; surface sculptured.

Basals form a short subhexagonal disc, gently concave below for the attachment of the column, and pierced by a round or slightly cinque foil opening for the columnar canal. First radials large, of unequal size, rapidly expanding to the lateral angles, one-half wider than higher, three hexagonal and two heptagonal; the two hexagonal plates adjoining the azygous area are smaller than the others. Second radials about two-thirds the size of the first and of unequal size and shape; the one opposite the azygous area is quadrangular, and twice as wide as high, and anchylosed with the third radial, so the suture is very indistinct in our specimen. The others are more or less distinctly hexagonal, depending upon the truncation of the superior lateral angles, by the adjacent interradials; some of the angles are broadly truncated, and others barely touched. The second radials are much more convex longitudinally than the first, which gives the calyx at this place a marked pentagonal outline. The third radials are of very unequal size, smaller than the second, from one and a half to two and a half times as wide as high, pentagonal, axillary, and have the superior angles directed almost horizontally, and from these plates upward the rays are all directed horizontally. The third radial on the right of the azygous area bears upon each upper sloping side a single secondary radial which is short, wide, pentagonal and axillary, and bears upon each upper sloping side at least three tertiary radials before the arms are free from the plates of the vault. This arrangement gives to this ray four arms. The third primary radials in each of the other four radial series bear upon the left upper sloping side a single secondary radial, which bears upon its upper sloping sides at least three tertiary radials, but the other sloping side of the third radial bears only secondary radials, which gives to each of these four radial series three arms. The species, therefore, possesses sixteen arms before they become free from the plates of the calyx and vault. The arms consist of a single series of transverse plates, but we know nothing of what bifurcations, if any, take place. The plates of the vault and interradial areas cover the top and sides of these horizontal extentions of the secondary and tertiary radials, leaving the interradial areas deeply depressed between them.

The first regular interradial, in each area, is a large plate that rests between the superior sloping sides of the first primary radials, separates the second primary radials, and supports upon its upper sloping sides two rather large plates that separate the secondary and tertiary radials. These plates in the second interradial range unite with the plates of the vault and the sides of the projecting radial series, but our specimen is too much injured to follow further the order of arrangement.

The first azygous plate is heptagonal, of the same size and in line with the first primary radials. It is followed by three rather large plates in the second range, that separate the second primary radials, and, in turn, these are succeeded by a range of five somewhat smaller plates that separate the adjacent secondary and tertiary radials. The third range, as thus indicated, is succeeded by ranges of plates that cross the wide azygous area and form the sides of the projecting radial series and thus unite with and become part of the plates belonging to the vault. The graduation from the plates of the calyx to those of the vault leave no definite line of separation between them.

The vault is convex and possessed of a balloon-like prominence on the azygous side, part of which only is preserved in our specimen, but it is certainly peculiar and distinct from that belonging to any other described species. The opening appears to have been seven or eight ranges of plates higher than the third range of plates in the azygous area. All the radial areas are high, with abruptly descending interradial areas to correspond with the horizontally projecting arms above described. The plates of the vault and balloon-shaped prominence are large, convex and polygonal, with a smooth or finely granular surface. The plates directly over the junction of the ambulacral passages bear spines and each one over the junction of the ambulacral passages belonging to the five radial series is particularly robust, though not of great length. Our specimen is too much injured upon the vault for a minute and careful definition of it, but the injury is mechanical and what we have is in a good state of preservation.

This is a remarkable species, and quite distinct from all hitherto described, though we think it is clearly referable to *Dorycrinus*.

Found by G. K. Greene, in whose honor we have proposed the specific name, in what is called the Knobstone Group, at Button Knobs, in Bullitt county, Kentucky, and which we suppose is the age of the Keokuk Group. The specimen described is now in the collection of Wm. F. E. Gurley.

BATOCRINUS COPIOSUS, n. sp.

Plate V, Fig. 5, azygous view of calyx and vault: Fig. 6, opposite view of same, specimen slightly compressed.

Body rather above medium size. Calyx broadly truncated at the base, one-half wider than high, arm openings directed twenty degrees above a horizontal line; plates thick, convex; sutures distinct; surface granular.

Basals short, thick, and forming a low, hexagonal cup, four times as wide as high, with a round hemispherical depression radiately furrowed for the attachment of the column. The thickness of the plates outside the column is about equal to half its diameter. They stand upright and are beveled toward the sutures. First radials the largest plates in the calyx, twice as wide as high, unequal in size, three hexagonal, two heptagonal, and each one bears a highly convex, transverse, obtusely angular ridge. Second radials small, quadrangular, and more than twice as wide as long. Third radials small, pentagonal, rather wider than the second, about twice as wide as high, axillary, and bear upon each upper sloping side the secondary radials. There are two secondary radials in each series except in one opposite the azygous area where there are four secondary radials upon each side of the third radial. The first secondary radials in the four series are small and quadrangular. The second secondary radials in the four series are rather large, wide plates, bearing a transverse ridge, axillary, and support upon each upper sloping side three tertiary radials. There are, therefore, four arms, in each of four series, and two arms in the ray opposite the azygous side, or eighteen arm openings to the vault.

There is only a single regular interradial in each area, one has nine sides, another ten, another eleven and the other twelve sides. Each one bears a prominent central node. There are four plates in the azygous area; the first one is larger than a regular interradial, is in line with the first radials, though somewhat higher, and bears a transverse convex ridge, it is followed by three plates, each about the size of a regular interradial and each bearing a central node.

The vault is quite as large as the calyx, most ventricose on one side, and bears a subcentral proboscis. It is covered by large, nodose, polygonal plates. There are two pores penetrating the vault between each of the radial series.

There is of course some resemblance between all species of *Batocrinus* having, as in this case, a subequal calyx and vault; but there is no necessity for comparing this species with any of them bearing eighteen arms, as the least care will distinguish it.

Found in the Kaskaskia Group, on Little Barren river, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS SACCULUS, n. sp.

Plate V, Fig. 7, view of calyx, vault and part of the column, opposite the azygous area; Fig. 8, basal view, azygous side up; Fig. 9, summit view of same, azygous side down.

Body medium size. Calyx somewhat saucer-shaped, three times as wide as high; arms directed horizontally; plates convex; sutures distinct; surface granular. Our specimen is a little depressed below, so as to produce an unnatural concavity around the column, and, therefore, does not show the full height of the calyx; it appears to be four times as wide as high, but remove the depression and it will not be more than three times as wide as high. The column is round, and plates rather thick and beveled toward the sutures so as to make them sharply angular in the middle.

Basals small, low, and extending only a little beyond the column. First radials small, one-half wider than high. Second radials two-thirds as large as the first, quadrangular and only a little wider than long. Third radials very little larger than the second, four pentagonal, the one opposite the azygons area heptagonal, axillary and bear upon each upper sloping side the secondary radials. There are two secondary radials in each series, four of which are axillary and bear upon each upper sloping side a tertiary radial. In the ray opposite the azygous area the second secondary radials are rather large and bear the free arms. This gives to the species eighteen arms. The arms are small and directed horizontally.

There are three plates in each regular interradial area, the first are the larger plates of the calyx, and each is followed by two rather long plates. In one or two of the areas there is a small plate above these. The first azygous plate is a little larger than the first radials and it is followed by four plates in the second series; above these the sutures are obscure in our specimens but apparently there are three in the third series and above these there is one or two plates that connect with the plates of the vault.

The vault is convex, most venticose on the side opposite the azygous area. It is fully as large as the calyx and bears a very small subcentral proboscis. It is covered with rather large, polygonal, convex plates, and is slightly depressed in the interradial reas.

This species somewhat resembles in form, *B. spergenensis*, but differs in the interradial and azygous areas, beside that is a twenty armed species while this has only eighteen. It will not be mistaken for any hitherto described.

Found in the Warsaw group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

PLATE I.

PAGE.

HOLOCYSTITES GYRINUS, n. sp. 5

Fig. 1. Ventral view.
Fig. 2. Posterior view.
Fig. 3. Summit view.

BELEMNOCYSTITES WETHERBYI, n. sp. 9

Fig. 4. Dorsal view of the specimen figured by Prof. Wetherby.
Fig. 5. Dorsal view of the type specimen.
Fig. 6. Ventral view of the same.

HOLOCYSTITES SPLENDENS, n. sp. 7

Fig. 7. Left anterior view.
Fig. 8. Right posterior view.
Fig. 9. Summit view.

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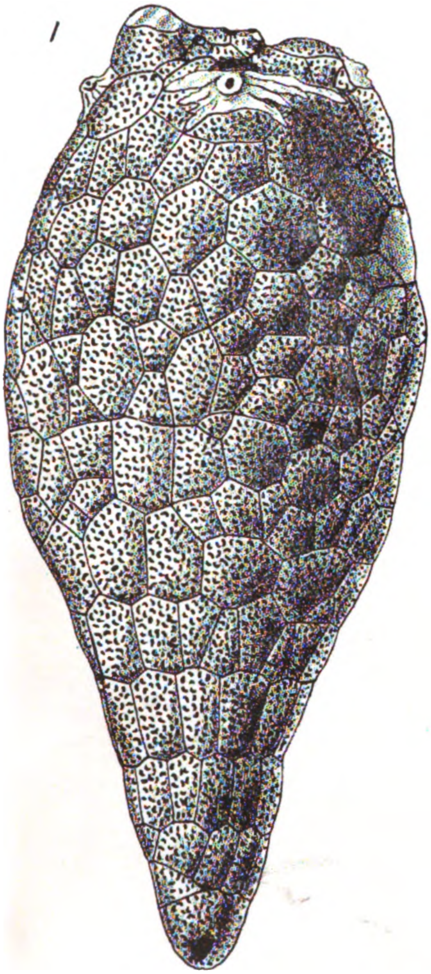

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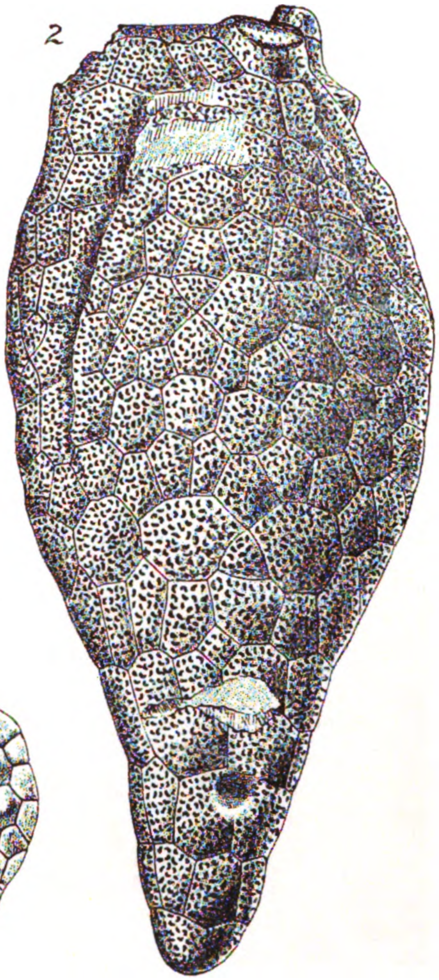

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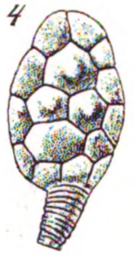

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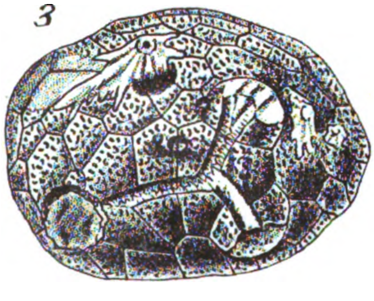

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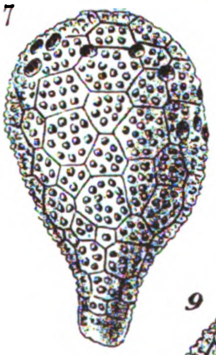

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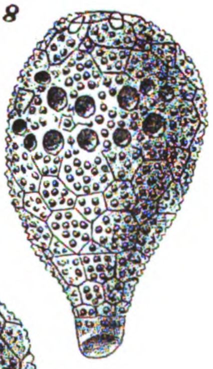

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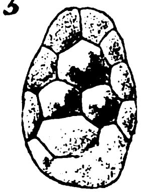

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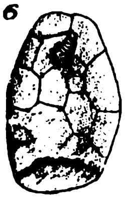

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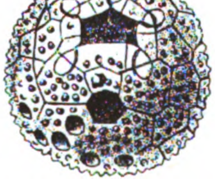

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PLATE II.

Page.

Archæocrinus peculiaris, n. sp. 17
- Fig. 1. Lateral view.
- Fig. 2. Azygous side view.
- Fig. 3. Basal view.

Mitrocrinus wetherbyi, n. sp. 22
- Fig. 4. Azygous side view.
- Fig. 5. Basal view.
- Fig. 6. Summit view.

Archæocrinus asperatus, n. sp. 19
- Fig. 7. Basal view.
- Fig. 8. Summit view.
- Fig. 9. Azygous side view.

Æsiocystites priscus, n. sp. 14
- Fig. 10. Summit view.
- Fig. 11. Summit view of another specimen.
- Fig. 12. Lateral view.

Caryocrinus ellipticus, n. sp. 10
- Fig. 13. Anterior side view.
- Fig. 14. Summit view.

Caryocrinus bulbulus, n. sp. 11
- Fig. 15. Anterior side view.
- Fig. 16. Posterior side view.
- Fig. 17. Summit view.
- Fig. 18. Basal view.

Porocrinus kentuckiensis, n. sp. 24
- Fig. 19. Lateral view.

Carabocrinus ovalis, n. sp. 25
- Fig. 20. Azygous side view.
- Fig. 21. Opposite side of same specimen.

Retiocrinus alveolatus, n. sp. 26
- Fig. 22. Azygous side view.

Glyptocrinus mercerensis, n. sp. 28
- Fig. 23. Azygous side view.

Calceocrinus kentuckiensis, n. sp. 29
- Fig. 24. Anterior side view.
- Fig. 25. Posterior side view.

Archæocrinus parvus, n. sp. 21
- Fig. 26. Basal view.
- Fig. 27. Azygous side view.
- Fig. 28. Summit view.

Poteriocrinus circumtextus, n. sp. 31
- Fig. 29. Azygous side view.
- Fig. 30. Opposite side of same specimen.

Zeacrinus grandiculus, n. sp. 32
- Fig. 31. Azygous side view.
- Fig. 32. Opposite side of same specimen.

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Bulletin No 5. Plate II.

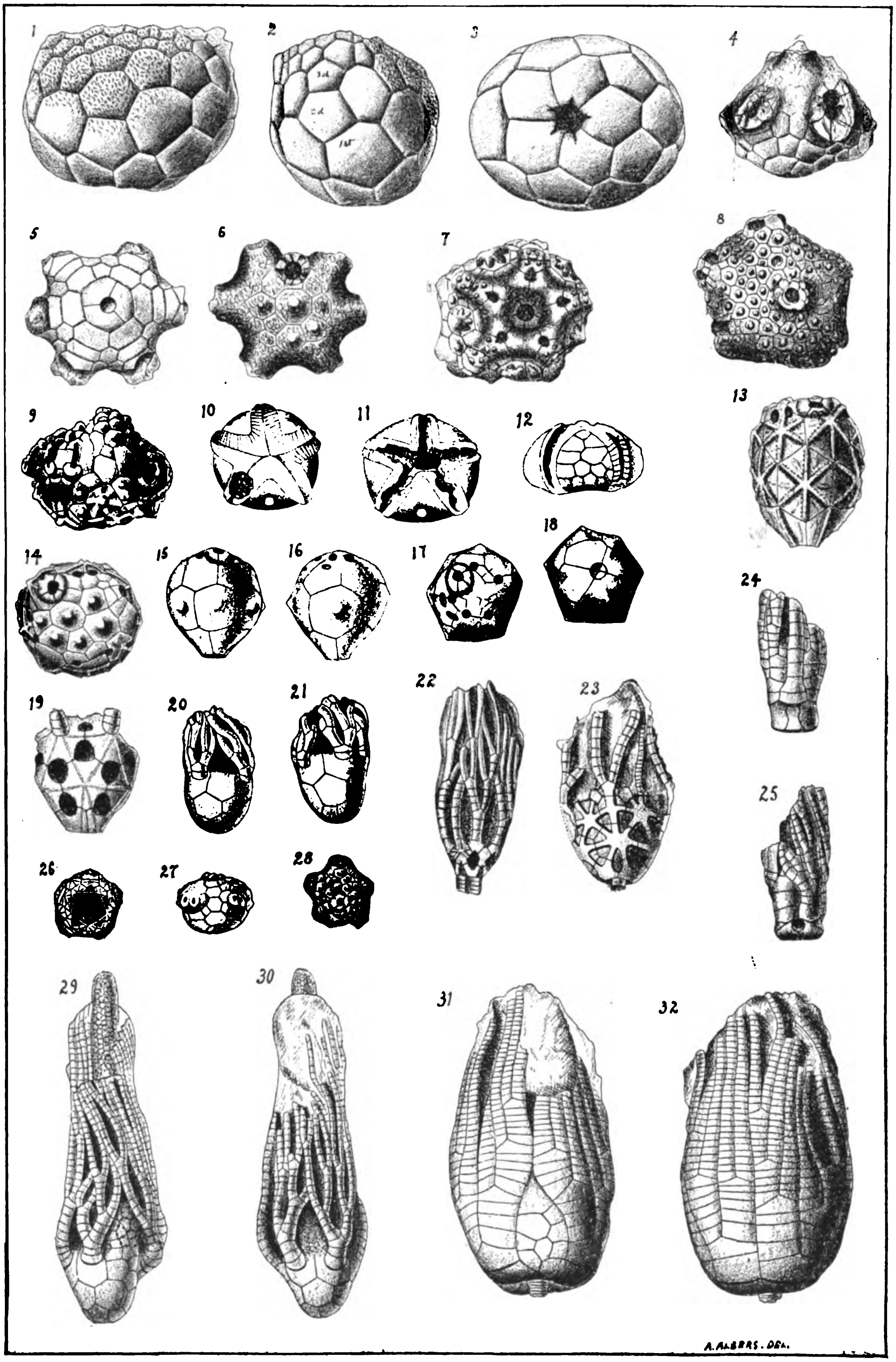

PLATE III.

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Poteriocrinus scopæ, Miller & Gurley 33
- Fig. 1. Lateral view, magnified two diameters.
- Fig. 2. Lateral view of same, natural size.

Poteriocrinus maccabei, n. sp 34
- Fig. 3. View of posterior side, natural size.
- Fig. 4. Same, magnified two diameters.
- Fig. 5. Azygous side of same, magnified two diameters.
- Fig. 6. Same, natural size.

Poteriocrinus hammondi, n. sp 35
- Fig. 7. Azygous side view, magnified two diameters.
- Fig. 8. Same, natural size.

Poteriocrinus maccabei, var. decrepitus, n. var 36
- Fig. 9. Azygous side view, magnified two diameters.
- Fig. 10. Opposite side view, magnified two diameters.
- Fig. 11. Azygous side view, natural size.
- Fig. 12. Opposite side view, natural size.

Agelacrinus legrandensis, n. sp 15
- Fig. 13. Two examples, natural size.
- Fig. 14. Same, magnified two diameters.

Platycrinus cortina, n. sp 40
- Fig. 15. Lateral view of calyx.
- Fig. 16. Summit view of same.

Zeacrinus salemensis, n. sp 37
- Fig. 17. Lateral view.

Agelacrinus pulaskiensis, n. sp 16
- Fig. 18. View of type specimen.

Zeacrinus cylindricus, n. sp 38
- Fig. 19. Azygous side view.
- Fig. 20. Azygous side view of a smaller specimen.
- Fig. 21. Opposite view of same.

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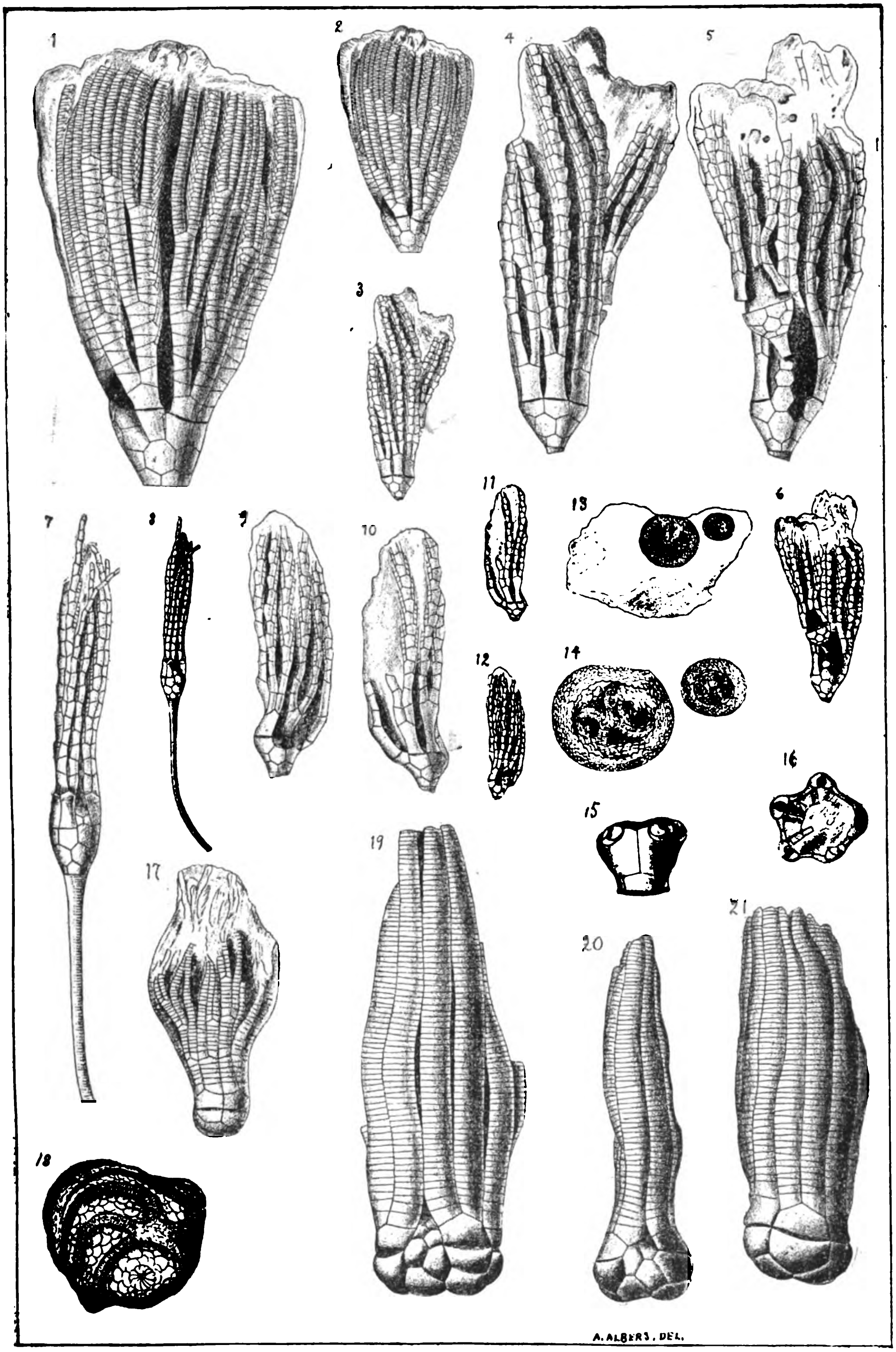
Bulletin No. 5. Plate III.



A. ALBERS. DEL.

PLATE IV.

Page.

ACTINOCRINUS MONTICULIFERUS, n. sp. 46
  Fig. 1. Azygous side view of calyx.

BARYCRINUS EXPANSUS, n. sp. 41
  Fig. 2. Basal view of calyx—azygous side down.

SYNBATHOCRINUS ANGULARIS, n. sp. 42
  Fig. 3. Lateral view of calyx and part of arms.
  Fig. 4. Azygous side view of same specimen.

ICHTHYOCRINUS CLARKENSIS, n. sp. 43
  Fig. 5. Lateral view.

DOLATOCRINUS AMPLUS, n. sp. 45
  Fig. 6. Basal view.
  Fig. 7. Side view.
  Fig. 8. Vault.

ALLOPROSALLOCRINUS CELSUS, n. sp. 47
  Fig 9. View of calyx opposite azygous side.
  Fig. 10. Azygous side view.
  Fig. 11. Basal view.

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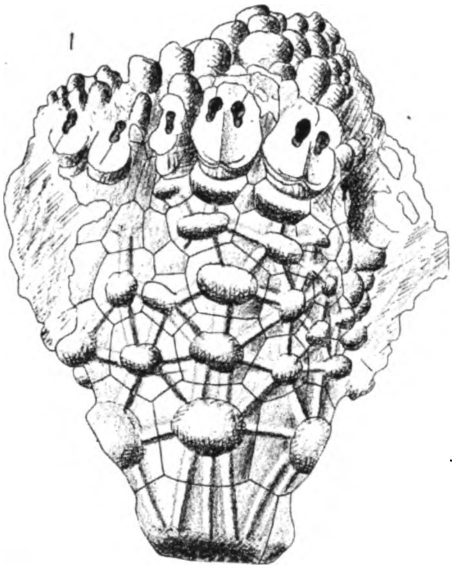

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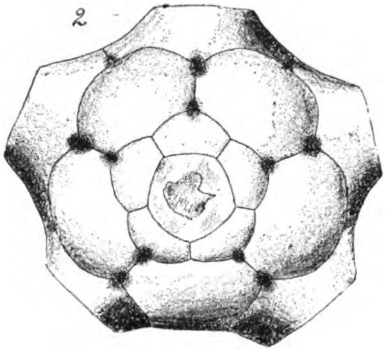

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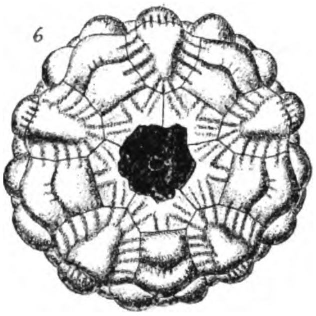

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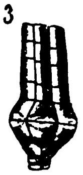

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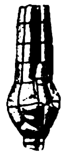

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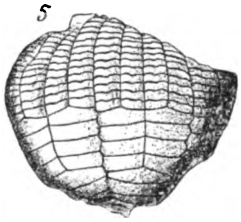

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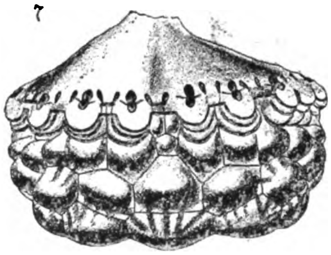

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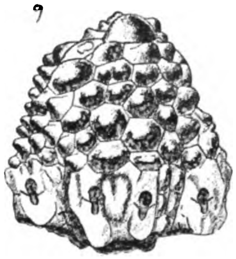

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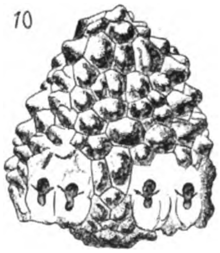

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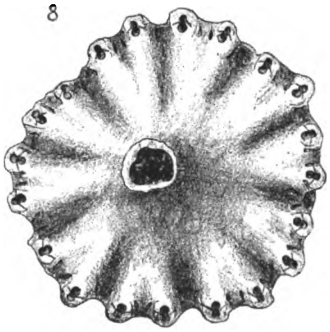

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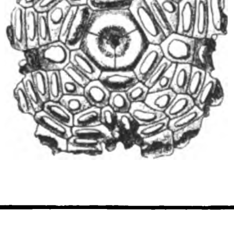

A. ALBERS. DEL.

PLATE V.

PAGE.

DORYCRINUS GREENEI, n. sp. 48
- Fig. 1. Basal view.
- Fig. 2. Azygous side view.
- Fig. 3. Vault.

ICHTHYOCRINUS SPINOSULUS, n. sp. 44
- Fig. 4. Lateral view.

BATOCRINUS COPIOSUS, n. sp. 51
- Fig. 5. Azygous side view.
- Fig. 6. View of calyx opposite azygous side.

BATOCRINUS SACCULUS, n. sp. 52
- Fig. 7. View of calyx opposite azygous side.
- Fig. 8. Basal view, azygous side up.
- Fig. 9. Vault, azygous side down.

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Bulletin No. 5. **Plate V.**

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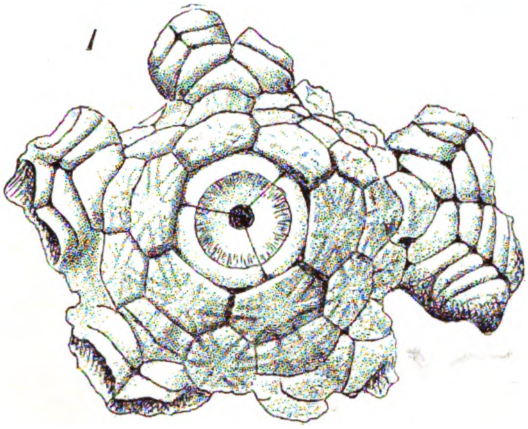

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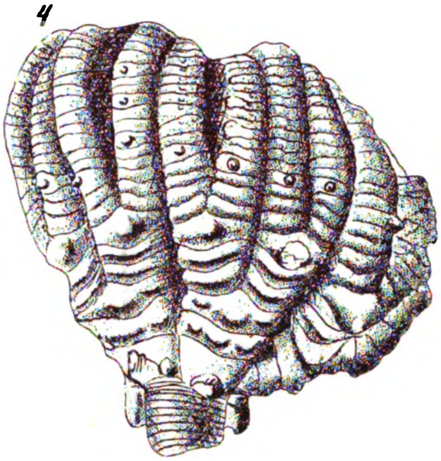

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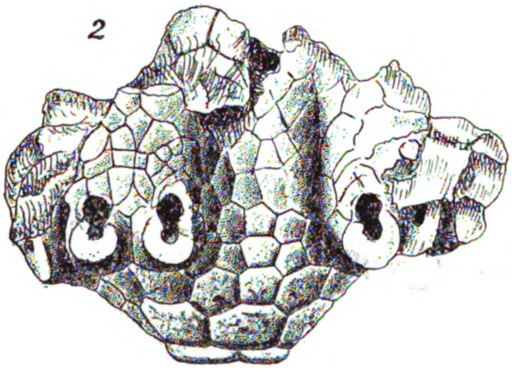

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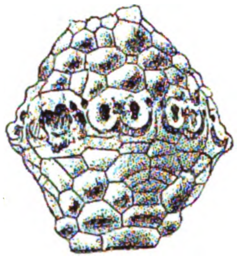

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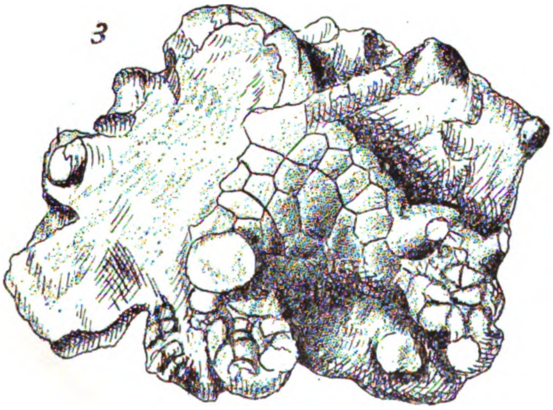

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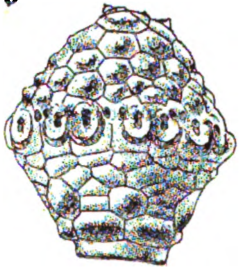

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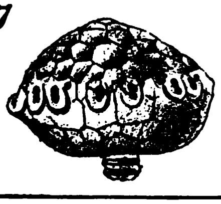

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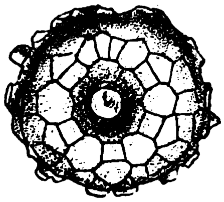

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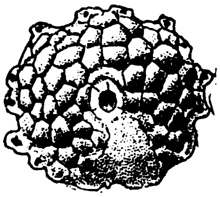

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BULLETIN NO. 6

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY

DESCRIPTION OF NEW SPECIES OF PALÆOZOIC ECHINODERMATA.

5 plates

By S. A. MILLER and Wm. F. E. GURLEY.

Springfield, Illinois,
April 5, 1895.

SPRINGFIELD, ILL.
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DESCRIPTION OF NEW SPECIES OF PALÆOZOIC ECHINODERMATA.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA

FAMILY ACTINOCRINIDÆ.

BATOCRINUS SPINOSUS, n. sp.

Plate I, Fig. 1, azygous side; Fig. 2, opposite view; Fig. 3, basal view of the same specimen, azygous side down.

This species is above medium size. The calyx is short, three times as wide as high, subpentagonal in outline. The vault is high and inflated. All the plates of the body are produced in wedge-shaped, irregular spines, part of which are broken off our specimen.

Basals short and forming a low, saucer-shaped cup, with a moderately concave depression below, for the attachment of the column. First primary radials twice as wide as long, and each bearing a transverse, wedge-shaped spine, directed downward, that extends lower than the facet for the columnar attachment. Second primary radials short, about three times as wide as long, quadrangular. Third primary radials, wider than long, pentagonal, axillary, and in four rays there is a single secondary radial upon one superior sloping side which is axillary and bears upon each upper side three tertiary radials, and upon the other superior side there are three secondary radials, which arrangement gives to each of the four rays three arms. In the ray opposite the azygous area, the third primary radial bears upon each upper side three secondary radials and consequently has only two arms. There are, therefore, fourteen arms, in this species, and fourteen ambulacral openings to the vault.

The regular interradial areas are not exactly alike. In two of them there is a single plate and in the other two areas a small plate follows the first one. In the azygous area, the first plate is in line with the first radials and it is followed by three plates of nearly equal size, giving to this area a subquadrate outline.

The vault is enormously developed, most tumid opposite the azygous area and covered with large, polygonal, unequal, and remarkably heavy spinous plates. The proboscis is large, subcentral and slightly curved back from the azygous side. There are two pores that penetrate the vault between each of the arms or twenty-eight of these passages in the species.

This species is distinguished by the development of each radial series at the periphery of the calyx which gives to the calyx its subpentagonal outline; by the great development of the vault; by the robust spinous plates and fourteen arms. It has some resemblance to *Eretmocrinus prægravis,* which is a twelve armed species and has more plates in the azygous and regular areas. It may be said to be constructed upon a similar plan, though not to be mistaken for that species. We think that *Eretmocrinus prægravis* should be referred to *Batocrinus,* and possibly the genus *Eretmocrinus* abandoned, at least, the large proboscis, no matter how much it may be curved, will not alone distinguish *Eretmocrinus.*

Found by Prof. A. G. Wetherby, in the Keokuk Group, on Little Barren River, Kentucky, and now in the collection of Wm. E. E. Gurley.

BATOCRINUS CURIOSUS, n. sp.

Plate I, Fig. 4, azygous side; Fig. 5, opposite view; Fig. 6, basal view.

Species large, vault exceeding the calyx in dimension. Calyx more than twice as wide as high, truncated below, regularly expanding to the first tertiary radials, and then spreading nearly horizontally to the free arms. Ambulacral openings directed horizontally. Each primary, secondary, tertiary and quaternary radial series consists of a sharp ridge that slopes laterally to the sutures, the sharp angularity increases from the first primary to the last quaternary plate, each plate also bears a sharp central node or tubercle. All other plates of the calyx are tumid and each bears a central node. Surface granular. Column large and contains a large canal.

Basals very short, wide, truncated below, lateral sutures deep, superior face of each concave, truncated face about twice the diameter of the column, the facet for which is only moderately concave and radiately furrowed. First primary radials of unequal size, from two to four times as wide as long, superior face concave, three hexagonal, two heptagonal, and each bears three nodes, one central from which the angular radial ridge arises, and one on each prolonged lateral side. Second primary radials of unequal size, from one and a half to two and a half times as wide as long, quadrangular. Third primary radials about one half larger than the second, pentagonal, axillary and support on each upper sloping side, two secondary radials. The secondary radials are as large as the second and third primaries. The second secondary radials are axillary, and, in three rays, bear upon one of the superior sloping sides two tertiary radials, the second one of which is axillary and bears upon each superior sloping side three quaternary radials, and upon the other side of the second secondary radials, which are the proximal sides, four tertiary radials, which arrangement gives to each of the three rays six arms. In the ray opposite the azygous area and in one of the lateral rays each second secondary radial is axillary and bears upon each upper sloping side four tertiary radials, and consequently these rays have four arms. There are, therefore, twenty-six arms in this species and twenty-six ambulacral openings to the vault. There are no intersecondary or intertertiary plates.

In two of the regular interradial areas there is one large plate followed by a small one, and in the other two areas there is a large plate followed by two small ones. These plates are tumid and each bears a central node. The azygous area is somewhat trapezoidal in outline and contains seven plates. The first one is in line with the first primary radials, but is much larger than either of them and bears a large transverse wedge-shaped spine. It is followed by three tumid, nodose plates in the second range, and these, in turn, by two plates, one of which is quite small, and above the larger plate, in the third range, there is a small plate in the fourth range, which is immediately below the angle formed by the union of the first quaternary plates.

Vault high, broadly rounded, most tumid opposite the azygous side and covered with polygonal, nodose plates. The larger plates bear two, three or more nodes, but the smaller ones bear a single central node. The proboscis is subcentral on the azygous side. There are narrow, elongated plates at the base of the vault, between the plates covering the ambulacral furrows, except between the furrows belonging to the quaternary series of radials, and at the inferior angles of these elongated plates there are pores penetrating the vault, making, in all, forty of these so-called ovarian orifices.

This species is distinguished by its general form, sharp radial ridges, tumid and nodose plates, and twenty-six arms. It is not necessary to make any special comparison with any heretofore described.

Found by Prof. A. G. Wetherby in the Keokuk Group, in Allen County, Kentucky, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS CASULA, n. sp.

Plate I, Fig. 7, azygous view; Fig. 8, side view of the same specimen, part being broken away opposite the azygous side

Species large, calyx and vault subequal in size. Calyx one-half wider than high, bowl-shaped, most rapidly expanding above the secondary radials, and ambulacral openings directed nearly horizontally. Radial ridges angular and in the tertiary and quaternary series embracing the entire plates to the lateral sutures, and each plate bears a central node. All the plates of the calyx are tumid and each bears one or more nodes. Surface granular. Column large.

Basals short, twice as wide as high, bear a tubercle at each side, and form a low hexagonal disc, one-half wider than the column, each superior face concave and lateral sutures deep. First primary radials of unequal size, from one-half wider to twice as wide as long, superior face transverse or slightly concave, three hexagonal, two heptagonal and each bears a central node, and the larger ones have small lateral nodes. Second primary radials comparatively small, quadrangular, and about one-half wider than high. Third primary radials about one-half larger than the second, pentagonal, axillary, and support on each upper sloping side two secondary radials, and in one of the rays in our specimen there are three secondary radials. The secondary radials are larger than the second and third primaries, and the last one is axillary in all the rays. Above this some of the rays are injured in our specimen. The lateral ray shown in figure 8 has four tertiary radials upon each upper sloping side of the last secondaries which gives to this ray four arms. The ray shown on the right of the azygous area in figure 7 has four tertiary radials on each of the upper proximal sides of the second secondaries, and two tertiary radials on each of the upper distal sides, the last of which is axillary and supports upon each upper side three quaternary radials, which arrangement gives to this ray six arms. The species evidently has either twenty-four or twenty-six arms. The arms are in clusters of two or three that project and have depressed interspaces, that are most conspicuous on the vault, but give a very irregular outline to the top of the calyx.

In each of the regular interradial areas there are four plates. The first is very large; it is followed by two plates of unequal size, and above these there is a smaller one. The azygous area is much elongated and contains seven plates. The first one is in line with the first primary radials, and nearly as large as any of them. It is followed by three plates sub-equal in size and about as large as the first. These are followed by two plates, one quite small and the other about as large as those in the second range. Above these there is an elongated plate in the fourth range that sends an angle high between the quaternary radials, and to near the top of the calyx.

The vault is convex, irregular, depressed in the interradial areas and covered with remarkably large, polygonal, peculiar, nodose plates. Some of the plates bear a large, wedge-shaped spine; others bear one, two or three nodes, more or less irregularly defined. The proboscis is subcentral, but broken off in our specimen. Three elongated plates with nodes near the upper end may be seen over the azygous area in figure 7, and two orifices penetrating the vault at their lower angles. One elongated plate may be seen in figure 8 separating the four armed series with two orifices penetrating the vault at the lower angles. And the plate separating the four armed from the six armed series is one-half longer than either one shown in the illustrations. Two pores penetrate the vault between each of the arms, except the quaternary series, and, therefore, there are forty of these so-called ovarian orifices.

This species bears more resemblance to *Batocrinus curiosus* than to any other heretofore described, though the vault differs so much from that, it will be wholly unnecessary to institute any comparison. The difference in the form of the calyx in the two species will account for the variations in the size and shape of the plates so far as the basal and radial series extend, but the differences in the number of interradials and shape of the areas will always constitute specific characters. The sharp radial plates in *B. curiosus* and depressed spaces between the bunched radial series in this species are not to be overlooked.

Found by Prof. A. G. Wetherby in the Keokuk Group, on Little Barren River, in Kentucky, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS HONORABILIS, n. sp.

Plate I, Fig. 9, azygous view; Fig. 10, opposite side same specimen.

Species large, with a vault less than half the height of the calyx. Calyx nearly as long as wide, hexagonal below and most rapidly expanded near the top. Plates tumid and subspinous, Ambulacral openings directed upward at an angle of thirty degrees. Column large and radiately furrowed.

Basals stand upright and form a hexagon about twice as wide as high and about twice as wide as the diameter of the column. They are beveled towards the sutures and flattened on the sides and extend to wedge-shaped end below the commencement of the column, so that the calyx will stand on the cuneiform edges. First primary radials large, nearly as long as wide, three hexagonal, two heptagonal. Second primary .radials a little wider than long, quadrangular. Third primary radials abut upon two interradials at one or both ends, and consequently four of them are hexagonal and one heptagonal; the heptagonal plate is shown in figure 10. They are very unequal in size, but each one is axillary and supports upon each of its two superior sides two secondary radials. The secondary radials are rather long and as large as the second and third primary radials, the second secondary radials are axillary and each supports on its superior sloping sides three tertiary radidals, and in some rays four tertiary radials. By this arrangement there are four arms in each radial series or twenty arms and twenty ambulacral openings to the vault in this species. There are no intersecondary or intertiary plates.

The regular interradial arms are much elongated and the two shown in figure 10 have each four plates, one in the first range, two in the second and one in the third. But in each of the other regular interradial areas there are three plates in line, the third one being the smallest. In the azygous area there are seven plates and it is somewhat trapezoidal in outline. The first one is as long as wide, larger than a first primary radial and in line with them. It is followed in the second range by three large plates and these by two in the third range and one in the fourth, which separates the first tertiary radials, and in these rays there are four tertiary radials.

The vault is subhemispherical or broadly rounded and bears a small subcentral proboscis which is broken off in our specimen. It is covered with large, tumid, polygonal plates, each of which bears a central mode. The interradial areas are slightly depressed between each pair of arms where there is an elongated plate and an orifice at each of its inferior angles. This arrangement places one pore on one side of each arm or gives to the species twenty of these so-called ovarian pores.

This species is distinguished by its general form, cuneiform basal plates, elongated interradial areas, twenty arms and nodose plates. It cannot be mistaken for any hitherto described.

Found by Prof. A. G. Wetherby, in the Keokuk Group of Tennessee and now in the collection of Wm. F. E. Gurley.

BATOCRINUS WETHERBYI.

Plate I, Fig. 11, azygous view; Fig. 12, opposite side of same specimen. The outer rim of the basals is broken off.

Species rather above medium size, biturbinate vault larger than the calyx. Plates of the vault tumid and nodose, while those of the calyx are smooth. Calyx twice as wide as high, truncated and expanded at the base, and broadly constricted in the region of the secondary radials, and having the last tertiary radials directed nearly horizontally. The surface is without radial ridges or other ornamentation except a granular covering.

The basals are truncated below and broadly expanded, but the outer rim is broken off in our specimen so the true diameter is not disclosed. The column is large and inserted in a concave radiately furrowed depression. The first primary radials are very short, from three to four times as wide as long, superior face concave, three hexagonal and two heptagonal. Second primary radials short, from two to three times as wide as long, quadrangular. Third primary radials very little larger than the second, pentagonal, axillary and supports on each superior sloping side two secondary radials. The secondary radials are larger than the second and third primary radials and considerably wider. The second secondary radials are axillary and bear on each superior sloping side two rather long tertiary radials. By this arrangement there are twenty arms and twenty ambulacral openings to the vault.

There is a single very large plate in each of two regular interradial areas and two plates in each of the other two areas, one rather large plate followed by a small one as shown in figere 12. There are five azygous plates. The first one is much larger than either of the first primary radials and in line with them. There are three plates in the second range, the middle one being much the smallest and quadrangular. There is a single wide plate in the third range which is nearly as large as the first. The azygous area is, therefore, nearly square in outline, with a small quadrangular plate in the center surrounded by four plates in the angles of the area.

The vault is high, subconical with a large subcentral proboscis. It is covered with large, tumid, nodose, polygonal plates. The interradial areas are slightly depressed between each pair of arms, where there is a narrow elongated plate and an orifice at each of its inferior angles. This arrangement places one pore on one side of each arm or gives to the species twenty of these so-called ovarian apertures.

This species is distinguished by its general biturbinate form, expanded basals, smooth calyx, nodose vault, square azygous area and twenty arms. It is a marked species that need not be mistaken for any heretofore described.

Found by Prof. A. G. Wetherby, in whose honor we have proposed the specific name, in the Keokuk Group, at White Creek Springs, in Tennessee, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS LATERNA, n. sp.

Plate I, Fig. 13, azygous area on the right; Fig. 14, basal view to show the diameter of the basal plates.

Species rather above medium size and having a lantern shape that suggested the specific name. Vault conical and larger than the calyx. Calyx more than twice as wide as high; basals thin and remarkably expanded in a circular disc; each radial series consists of a sharp ridge that slopes laterally to the sutures, while the interradial areas are flattened and depressed so that a transverse section of the calyx, at any point below the secondary radials, will be sharply pentagonal in outline. The calyx is abruptly expanded above the secondary radials so that the last tertiary radials are directed horizontally, in pairs, with a depressed interradial space between them. The angularity of the radial ridges is somewhat like it is in *Batocrinus curiosus*, but otherwise the calyces have no resemblance to each other.

The basals form a thin circular disc that has a diameter one-half greater than the height of the calyx, and, in the center of which, on the lower flat side, there is a concave radiately furrowed depression for the attachment of the column, and a small round columnar canal. The diameter of the column is about one-fourth the diameter of the basal disc. The first primary radials are short, two or three times as wide as high, have a concave face for the second radials, are longitudinally sharply angular in the middle, and appear as if set down upon the surface of the plane basal disc. Second primary radials short, sharply angular in the middle, quadrangular. Third primary radials very little larger than the second, pentagonal, axillary and bear upon each superior lateral side two secondary radials. The secondary radials are short, the last one axillary and supporting on each superior sloping side three tertiary radials. This arrangement gives to the species twenty arms and twenty ambulacral openings to the vault. The ambulacral openings are directed horizontally.

The regular interradial areas are depressed and flattened below the base of the radial ridges. Some of the matrix covers the plates in some of the areas so that they cannot be distinguished. In the area, on the left of figure 13, there are three plates, one in the first range and two in the second, one of which is much longer than the other. In the azygous area there are five plates. The first one is in line with the first primary radials, only about half as wide but somewhat longer than either one of them. It appears to stand up on the circular disc filling the middle part of the depressed and flattened area. It bears a small central tubercle, but all the other interradials are flat and smooth. It is followed by three rather large flat plates, in the second range, and above these, in the third range, there is a single, narrow, elongated plate that extends one angle high between the second tertiary plates, but is cut off from reaching the plates of the vault.

Vault very high, conical, larger than the calyx and bearing a large subcentral proboscis. The interradial areas are depressed between each pair of arm bases. The vault is covered with large, polygonal, and tumid plates, each one of which bears a large central node. There is a narrow elongated plate between each pair of ambulacral furrows and an orifice at each of its inferior angles. This arrangement places one pore on one side of each arm or gives to the species twenty of these so-called ovarian apertures.

The large round basal disc, pentagonal outline of the calyx, sharp radial ridges, depressed and flattened interradial areas, conical vault and twenty arms distinguish this species. There is no doubt but that the proboscis is large and long and that the basal disc is expanded, probably, beyond any other known species. Both of these characters are ascribed to *Eretmocrinus*, but there is no difficulty in showing, as we have before remarked, that the proboscis, alone, cannot be relied upon to distinguish the genera. The basal plates cannot be relied upon, for you may pass by a graded scale from the extraordinary basals, in this species, to those in *Batocrinus wetherbyi* and then to *Batocrinus curiosus* and then to *Batocrinus casula* where the basals are rounded instead of expanded. The only other character by which *Eretmocrinus* is distinguished from *Batocrinus* is found in the arms, and, as we shall have occasion to describe a species, in this paper, having the flattened arms belonging to *Eretmocrinus*, we will defer further comparison until that species is before us. If *Eretmocrinus*, however, is a valid genus, the probability is, that this species should be referred to it, in the absence of a knowledge of the arms, for, otherwise, the genus can only be known by the arms, which are rarely ever found, in chert or among silicified specimens. The species most nearly related to this one is *Eretmocrinus lyonanus*, though they are readily distinguished by the basal plates and interradial areas; differences, however, which are only specific, not generic. They both belong to the same genus.

Found by Prof. A. G. Wetherby, in the Keokuk Group, at White Creek Springs, Tennessee, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS LACINIOSUS, n. sp.

Plate 1, Fig. 15, view opposite the azygous area; Fig. 16, azygous side of same specimen.

Species medium size, one of our specimens is much smaller than the one illustrated. General form biturbinate; vault larger than the calyx. Calyx twice as wide as high, broadly truncated below and rapidly expanding from the secondary radials so as to direct horizontally the last tertiary radials and ambulacral openings. Plates on the lower part of the calyx tumid and subspinous, those on the superior part plane or slightly convex. Radial ridges undefined; sutures distinct.

Basals form a low hexagonal disc, one-half wider than the diameter of the column. Columnar depression concave and radiately furrowed, canal small. First primary radials large, only a little wider than long and each bears a robust, transverse, cuneiform node, three hexagonal, two heptagonal. Second primary radials very small, short, about twice as wide as long, quadrangular. Third primary radials about one-half larger than the second, pentagonal, axillary, and in the rays adjoining the azygous area, bearing on the distal sloping sides three secondary radials and on the proximal sides one secondary radial, which is axillary, and bears upon its superior sloping sides three tertiary radials, which gives to each of these rays three arms. In the two lateral rays the third primary radials bear upon each superior sloping side a single secondary radial, which is axillary and bears upon each upper sloping side three tertiary radials, which gives to each of these rays four arms. In the ray opposite the azygous area the third primary radial bears upon each upper sloping side three secondary radials which gives to this ray two arms. There are, therefore, in this species, sixteen arms and sixteen ambulacral openings to the vault.

There is a single large tumid plate in each regular interradial area. In the azygous area there are six plates. The first one is as large as a first primary radial, and in line with them, and bears equally as robust and cuneiform a spine. It is followed by three much smaller plates, in the second range, and these, in turn, by two plates, the lower one of which is much the smaller.

The vault is conical, larger than the calyx and bears a subcentral proboscis. It is covered with large subspinous plates. There is an elongated plate between each pair of arms and one dividing the three armed rays that separate the ambulacral coverings at the base of the arms and a pore penetrates the vault at each inferior angle of these narrow plates, which arrangement gives to this species eighteen of these so called ovarian apertures.

This species is distinguished by the general form, tumid plates on the lower part of the calyx and smooth plates in the superior part, azygous area and sixteen arms.

Found by Prof. A. G. Wetherby in the Keokuk Group, of Tennessee, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS CASUALIS, n. sp.

Plate I, Fig. 17, view opposite the azygous area; Fig. 18, azygous view of same specimen.

Species below the average size, biturbinate, vault and calyx subequal. Calyx broadly truncated below, only slightly expanded above and ambulacral openings directed upward at an angle of forty degrees. Diameter about one fifth greater than the height. Radial ridges not distinguished. A few of the plates in the lower part tumid, those in the upper part only slightly convex or plane.

Basal plates stand upright and form an hexagonal disc three times as wide as high, truncated below, and having a deep cavity for the insertion of the column, which is a little less than half the diameter of the basal disc. Columnar canal small. First primary radials large, one-fourth wider than high, three hexagonal, two heptagonal and each bearing a robust, transverse node. Second primary radials small, quadrangular. Third primary radials a little larger than the second, pentagonal and axillary. The second and third primary radials together much smaller than the first.

The third primary radials adjoining the azygous area bear on the distal sloping sides two secondary radials and on the proximal sloping sides one secondary radial which is axillary and bears upon its superior sloping sides two tertiary radials which gives to each of these rays three arms. In the two lateral rays the third primary radials bear upon each superior sloping side a single secondary radial, which is axillary and bears upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. In the ray opposite the azygous area the third primary radial bears upon each upper sloping side two secondary radials, which gives to this ray two arms. There are, therefore, in this species, sixteen arms and sixteen ambulacral openings to the vault.

There is a single, rather large, convex plate in each regular interradial area. In the azygous area there are four plates. The first one is in line with the first primary radials, though much smaller, and bears a central node. It is followed by two plates in the second range and one in the third, giving to the area a subquadrate outline.

The vault is conoidal, covered with tumid, polygonal plates and bears a subcentral proboscis. There are a few of the so-called ovarian apertures but they cannot be accurately determined in our specimen.

This species is distinguished by its general form, surface ornamentation, azygous area, and sixteen arms. When compared with *Batocrinus laciniosus* it will be noticed that the calyx is much longer and yet has one plate less in the secondary and tertiary series, beside the other differences. It belongs to one of the forms sometimes referred to *Eretmocrinus*, but we see no sufficient reason for so classifying it.

Found by Prof. A. G. Wetherby in the Keokuk Group of Tennessee, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS ARCULA, n. sp.

Plate II, Fig. 3, azygous side; Fig. 4, summit view; Fig. 5, basal view of same specimen.

Species rather above medium size and having a low calyx and convex vault. Calyx low, saucer-shaped and having a diameter more than four times its height. Radial ranges not defined and no surface ornamentation. Ambulacral openings directed horizontally. Surface smooth or granular, our specimen being silicified, the granular appearance may or may not represent the surface of the plates.

The basals extend a little beyond the column and form a subhexagonal band around the superior end of it, with a concave depression radiately furrowed for its attachment. The canal is small and cinque foil. The first primary radials short, about three times as wide as high; three hexagonal, two heptagonal, superior side slightly concave. Second primary radials small, short, quadrangular, two are three times as wide as high. Third primary radials very little larger than the second, pentagonal, axillary, and on the distal side of the two rays adjoining the azygous area bear two secondary radials, the last of which is axillary and bears two tertiary radials on each upper sloping side, and on the proximal side having a single secondary radial, which is axillary and bears three tertiary radials. In each of the two lateral rays there are two secondary radials on each upper sloping side of the third primary radials, the second one being axillary and supporting on each upper sloping side two tertiary radials. By this arrangement there are four arms to each of these four rays. In the ray opposite the azygous area the third primary radial bears upon each upper sloping side three tertiary radials which gives to it two arms. There are, therefore, eighteen arms to this species and eighteen ambulacral openings to the vault.

In three of the regular interradial areas one large plate is followed by two small ones, in the other area there are only two plates, one following the other. The azygous area is somewhat triangular or conical and contains nine plates. The first one is in line with the first primary radials and somewhat smaller. It is followed by three plates of nearly equal size in the second range, and these by three plates in the third range, on the side of the highest of which there is a small plate that might be referred to a fourth range though not extending as high as the middle plate in the third range, and on the apex of the middle plate there is a single plate that extends as high as the calyx and unites with two plates connecting with the vault.

The vault is two or three times as large as the calyx, most convex or tumid opposite the azygous side and covered with large, polygonal plates, each of which bears a central node, except in the azygous interradials where the plates are small and plane or very slightly convex. It bears a large subcentral proboscis. The arms are arranged in pairs and two pores penetrate the vault between each pair of arms, which gives to this species eighteen of these so-called ovarian apertures.

This species is distinquished by its form, large azygous area connected with the vault, and peculiar azygous interradius on the vault, and eighteen arms. It cannot be mistaken for any species heretofore described.

Found by Prof. A. G. Wetherby in the St. Louis Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS PILEUS, n. sp.

Plate II, Fig. 6, basal view slightly broken; Fig. 7, summit view; Fig. 8, side view of the same specimen.

This species is rather large in circumference, with an almost flat calyx and moderately convex vault, or plano-convex in outline. The cap-like form suggested the specific name. While the calyx is nearly flat, the radial ridges are distinctly convex. Ambulacral openings directed upward at an angle of thirty degrees and not visible in a basal view.

Basal plates form a flat disc very little larger than the diameter of the attaching column. First primary radials short, more than twice as wide as long, three hexagonal, two heptagonal. Second primary radials about two-thirds as large as the first, quadrangular. Third primary radials nearly as large as the first, pentagonal, axillary, and supporting on each upper sloping side two secondary radials. The second secondary radials are axillary and bear upon each superior sloping side three tertiary radials which gives to each ray four arms. There are, therefore, twenty arms in this species and twenty ambulacral openings to the vault.

There are three plates in each regular interradial area, one moderately large followed by two smaller ones. The azygous area is subovate in outline and contains eight plates. The first one is in line with the first primary radials and narrower and longer than either of them. It is followed by three plates in the second range and three in the third range, the middle and higher one of which is truncated by a small plate that extends to the top of the calyx and unites with the plates of the vault.

The vault is convex and twice as large as the calyx, most tumid opposite the azygous side. There are three large, convex plates over each ambulacral area, one over the place where each pair of ambulacral furrows unite and the other over the point where they all come together. There are also four or more large, convex plates near the base of the proboscis on the side opposite the azygous area. The interradial areas are slightly depressed and covered with smaller polygonal plates. Most of the sutures being destroyed in our specimen, these plates are not indicated in the illustrations. The vault is broken in our specimen so as to show no part of the subcentral proboscis. Two pores penetrate the vault between each pair of arms, which gives to this species twenty of these so-called ovarian apertures.

This species is distinguished by its general form, flattened calyx, ovate azygous area connected with the vault, regular distribution of large convex plates on the vault, and twenty arms. It cannot be mistaken for any species heretofore described.

Found in the St. Louis Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS BURKETI, n. sp.

Plate II, Fig. 9, showing column, calyx and arms, azygous view.

This species is rather above medium size and is founded on a single fine specimen on a slab. Of course, it does not disclose the entire calyx and as the arms are preserved the vault cannot be seen. The calyx is nearly twice as wide as high, and subhemispherical. Though somewhat lobed in the superior part there are no radial ridges or proper evidences of surface ornamentation. The column is round, medium size, and composed, within an inch of the calyx, of rather thick plates, every alternate one projecting beyond the other; but farther removed from the calyx, the projecting plates are at irregular distances from each other as shown in the illustration.

Basals form a low hexagonal cup, more than one-half wider than the diameter of the column and bearing a small rim or truncated bottom which contains the concave depression for the insertion of the column. First primary radials large, a little wider than high, three hexagonal, two heptagonal. Second primary radials rather large and about one-half wider than high. Third primary radials differ greatly in size, and part are pentagonal and others hexagonal. The one on the left of the azygous area is only a little larger than the second primary radial, pentagonal, axillary and bears on one side three secondary radials, and on the other which adjoins the azygous area one secondary radial which is axillary and supports on each upper sloping side two tertiary radials. The arms then bifurcate on the third plate, which gives to this ray six arms. The third primary radial on the right of the azygous area is hexagonal, axillary and bears on the side adjoining the azygous area two secondary radials, and on the distal side two secondary radials, the second one of which is axillary and bears upon each superior side one tertiary radial. The arms then bifurcate on the third plate, which gives to this ray six arms. It will be noticed that these rays are quite different and yet result in producing the same number of arms. The lateral rays, as far as they can be seen, on our specimen, appear to be constructed in the same manner as the two above described. The ray opposite the azygous side may have the same number of arms and it may have two less. We can see seventeen arms, the others are covered. The species, therefore, as near as can be ascertained has either twenty-eight or thirty arms. The arms are large, long, and composed of a double series of small interlocking plates, that bear long pinnules.

The regular interradial area on the left of the azygous side is elongated, extends to the vault and contains five plates. The first is medium size and rests between the superior sloping sides of two first primary radials; it is followed by two somewhat smaller plates in the second range, and these by one of about the same size in the third range, and this by an elongated plate in the fourth range, that separates the arm-bearing plates of the calyx and unites with the plates of the vault. No other regular area can be described from our specimen. The azygous area is elongate, subovate and contains nine or more plates. The first plate is in line with the first primary radials and quite as large. It is followed by three plates in the second range, and these by three in the third range, and these by two plates in the fourth range that separate the arm-bearing plates, and one of which unites with the plates of the vault.

This species will be distinguished by its smooth calyx, slightly lobed by the projecting radial series at the summit of the calyx, and depressed interradials, that separate the arm-bearing plates; by the shape of the regular and azygous areas and the number of plates which they contain, and their connection with the plates of the vault, which is so exceedingly rare in this genus; and by the structure of the radial series and number of arms. We know of no species with which it is necessary to make a comparison, or for which it might be mistaken.

Found by Mr. N. K. Burket, in the Keokuk Group, at Hamilton, Illinois, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS LABELLUM, n. sp.

Plate 2, Fig. 10, azygous side; Fig. 11, basal view; Fig. 12, summit view.

This species is medium size, depressed, biturbinate or resembling in outline a double convex lens. Calyx and vault subequal. Calyx saucer-shaped, about two and a half times as wide as high. Plates convex or transversely ridged, by being beveled toward the sutures, which are remarkably well defined. Ambulacral openings directed upwards at an angle of twenty degrees and not visible in a basal view.

The basals extend a little beyond the column and form a sub-hexagonal band around the superior end of it, with a concave depression radiately furrowed for its attachment, and in this respect, resembles *Batocrinus arcula.* First primary radials short, two or three times as wide as long, three hexagonal, two heptagonal. Second primary radials short, about twice as wide as long, quadrangular. Third primary radials a little larger than the second, three pentagonal, two hexagonal, axillary, and in four of the rays supporting upon each upper sloping side two secondary radials, the second one of which is axillary and bears upon each superior sloping side three tertiary radials which gives to each of these rays four arms. In the ray opposite the azygous area the third primary radial bears upon each upper side four secondary radials which gives to this ray two arms. There are, therefore, eighteen arms in this species and eighteen ambulacral openings to the vault.

There are three plates in each of three regular interradial areas, one large plate followed by two small ones. In the other area there are four plates, one large plate followed by two small ones in the second range and these by one in the third range. The azygous area is sub-ovate, in outline, and contains eight plates. The first is in line with the first primary radials and of about the same size. It is followed by three plates in the second range, and these by three plates in third range, above which, a single plate separates the first tertiary radials, while the second tertiary radials unite over its superior angle.

The vault is about the same size as the calyx and very much like it in outline. It is covered with numerous, tumid, polygonal plates, each of which bears a central node. There are two pores that penetrate the vault between each pair of arms or eighteen of these so-called ovarian apertures in the species.

This species is distinguished, by its general form; by the beveled plates of the calyx; by the azygous area and eighteen arms. There is no species with which it is necessary to make any comparison.

Found in Keokuk Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

ACTINOCRINUS BOTRUOSUS, n. sp.

Plate 2, Fig. 1, azygous side; Fig. 2, opposite side of the same specimen.

Species robust, above medium size. Calyx nearly as long as wide. Radial series prominent and inter-radial areas depressed so as to give it an obpyramidal form or sub-pentagonal outline to a transverse section. Plates thick, tumid, and each one bears a central node, which, on the larger plates, is elongated transversely. The rays are abruptly expanded above the third primary radials, leaving the inter-radial areas depressed, thus forming projecting clusters of each of the five radial series and directing the ambulacral openings nearly horizontally. The sutures are interrupted by radiating sculptures, that are so short that the sutures appear as if pitted.

Basals a little wider than high, very thick, contracted in the middle and at the upper part so as to leave an expanded rim projecting much beyond and below the point of attachment with the column and having widely gaping sutures below so that the calyx will stand on the projecting and contracted ends of the basal plates. Column round, radiately furrowed, and having a diameter a little more than one-third the greatest diameter of the expanded basals. First primary radials large, rather longer than wide, three hexagonal and two heptagonal. Second primary radials wider than high, hexagonal, and more than half as large as the first. Third primary radials as large as the second, heptagonal, and supporting upon each of the superior sides a single secondary radial which is axillary, and supports upon each of its superior sides two tertiary radials, the last of which is axillary and supports the free arms, in all the rays that are preserved to show that extent of development in our specimen, though some of the rays do not preserve the first arm plates. If the arms are alike, therefore, in these four rays there are eight to each one. In the ray opposite the azygous area, on one side of the third primary radial, there is a single secondary plate, which is axillary and supports on each upper side two tertiary radials, and on the other side there are three secondary radials, beyond which our specimen is not preserved. If the last secondary and tertiary radials are axillary, there are six arms in this series. By this arrangement, if the arms are uniform, there are thirty-eight arms to this species. But, we cannot be certain that all the arms are double, as we know in some instances in other species such is not the case. The greater probability is, however, that they are uniform and that the species possesses thirty-eight arms. The ambulacral openings come together on the first tertiary radial, and hence, if the projecting radial series were broken away, at this place, there would appear to be only nineteen ambulacral openings to the vault. There are no inter-secondary or inter-tertiary radials.

The first regular interradial is smaller than a second primary radial. It is followed by two smaller plates in the second range, and these by three smaller plates in the third range, which separate the lower part of the first secondary radials. Above this point there is some difference in the areas, and the plates are small and thrown out of any definite arrangement by being continued up the sides of the projecting arm series as well as covering the depressed interradial area and graduating into the plates of the vault without any line separating the plates of the calyx from those of the vault. In one of the areas there are in the fourth irregular range four plates and in another area there are five, these separate the first tertiary radials. The first plate in the azyzons area is smaller than a first primary radial and in line with them. It is followed by two plates, in the second range, each of which is nearly as large as a first regular interradial, and these are followed by a range of three plates which are somewhat smaller and separate the third primary radials. There are four plates in the fourth range and above this range the plates, in our specimen, are covered with the matrix so as to obscure the sutures, but the area above this does not seem to be different from the regular areas.

The vault is convex and covered with large polygonal plates over the ambulacral areas, each one of which is possessed of a large ventricose central node, while the interradial areas are abruptly sunken and covered with small plane plates. The proboscis appears to have been quite small and central though broken away from our specimen. The ventricose vault plates in this species are much like they are in *Actinocrinus monticuliferus* and the swelling may be due more or less to silicification.

This species is distinguished by its general form and structure from all others that have been described and it does not seem that a comparison with any of them will aid in distinguishing it.

Found by Prof. A. G. Wetherby, in the Keokuk Group of Tennessee, and now in the collection of Wm. F. E. Gurley.

SACCOCRINUS UMBROSUS, n. sp.

Plate II, Fig. 13, lateral view, with azygous area on the right; Fig. 14, lateral view, with azygous area on the left, same specimen.

Species large. Calyx urn-shaped below, but spreading at the top, so as to resemble a *Strotocrinus*, and which suggested the specific name. Only part of the spreading top is preserved in our specimen, but enough to show it is much wider than the height of the calyx. Plates thick and tumid. Sutures deep and beveled. Surface ornamentation, if any, destroyed and also the plates of the vault in our specimen.

Basals one-half wider than high, very thick, stand upright and form a hexagon two and a half times wider than the diameter of the column. The basals extend below the point of attachment with the column in the form of cuneate ends with widely gaping sutures below, so that the calyx will stand on the sharp and contracted edges of the basal plates. The calyx rapidly expands in rounded outline from the basals to the second primary radials. First primary radials large, of unequal size, width about one-fourth greater than the height, three hexagonal, two heptagonal. Second primary radials about one-third the size of the first, quadrangular and nearly square. Third primary radials a little larger than the second, three hexagonal, two pentagonal, axillary, and support on each upper sloping side one or more secondary radials, the last of which is axillary and supports tertiary radials, and in some of the rays, at least, there are quaternary radials. All of the rays in our specimen are injured at some point above the first secondary radials, so that no single ray can be completely described.

The first plate in each regular interradial area is large, and in the first area on the left, as shown by figure 13, there are only three plates, one following the other. In one of the other areas there appears to be only two, but this appearance may be due to an injury that exists above the second plate. In the azygous area there are nine plates, in subovate outline, that appear to fill this area, but there is a large plate above these that does not seem to belong to the radial series, and hence there is doubt about the area. The first plate is in line with the first primary radials and of about the same size. It is followed in the second range by three large plates, and these, in the third range, by three smaller plates, and above these there are two still smaller plates that belong to this area.

This species is so different from any other that has been described, in the part preserved, that no comparison with any of them will throw any light upon it.

Found in the Niagara Group at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

ERETMOCRINUS COMMENDABILIS, n. sp.

Plate II, Fig. 15, a specimen showing part of calyx, arms and column, azygous area on the right.

Species large. Calyx twice as wide as high, depressed in the interradial areas and somewhat lobed in the superior part, broadly truncated below. Plates moderately convex and granular, sutures distict and more or less beveled. Column large and composed of thick plates that are beveled externally, and alternately project one beveled edge beyond the other. Columnar canal large and nearly round. Basals short, truncated below and expanded to a thin edge, irregularly hexagonal, in outline, and having a width twice the diameter of the column. First primary radials a little wider than high, three hexagonal and two heptagonal. Second primary radials short, more than twice as wide as high, quadrangular. Third primary radials a little larger than the second, pentagonal, axillary, and support on each superior sloping side two secondary radials. The secondary radials are larger than the second and third primary radials, the second one is axillary and supports on each superior sloping side two tertiary radials. This arrangement gives to the species twenty arms. This is upon the assumption that the arm opposite the azygous area is like the three that are shown in the specimen, it being possible that it has only two arms. There are three single short plates in the commencement of each arm, these are followed by a double series of interlocking plates that are deeper than wide but which gradually widen, until at the distance of an inch and three-quarters from the calyx an arm is three times as wide as deep.

In the only regular area shown in our specimen there are two plates, one quite large followed by another half its size. The first azygous plate is in line with the first primary radials and of about the same size. It is followed by three large plates and above these there are either one or two plates, that extend to the top of the calyx and connect with the plates of the vault.

This species is distinguished by its general form, depressed interradial areas, lobed extention at the arm bases, by the plates of the azygous and regular areas, and otherwise. It is a typical *Eretmocrinus* and the question now arises whether or not it can be distinguished from *Batocrinus*. The expanded basal plates is certainly not a generic character in *Actinocrinus* or *Batocrinus*, it is not peculiar to *Eretmocrinus*. Can it be, that taken in connection with the coarse and expanded arms, it becomes of generic value? We think not. The column is larger than is usual in *Batocrinus*, but that is certainly not a generic character. The form of the calyx and arrangement of the plates is the same as in *Batocrinus*. The only distinguishing difference left between *Eretmocrinus* and *Batocrinus* is to be found in the expansion of the arms. We believe that, in no instance, can this be of generic importance and, therefore, think that *Eretmocrinus* is separated from *Bactocrinus* by specific differences only. A mere combination of specific differences, which, if applied to its full extent, to *Batocrinus*, would subdivide the genus into many genera. We have, however, retained the name *Eretmocrinus*, from deference to the opinion of others, and provisionally, because it may be a convenient division of *Batocrinus*.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

AGARICOCRINUS PROFUNDUS, n. sp.

Plate 3, Fig. 1, basal view; Fig. 2, summit view; Fig. 3, azygous view of a smaller specimen.

Species large and preserving all the characters ascribed to it in numerous specimens. Calyx deep, hemispherical, outline subpentagonal. Plates within the concavity below the third radials, plane and smooth, and those from the third radials outward very tumid. The abrupt change from plane to tumid plates forms a rim within the concavity.

Basals small and entirely hidden by the column. First primary radials large, length about equaling the greatest width, a small part abruptly bent into the columnar concavity, three hexagonal two heptagonal. Second primary radials large and nearly square. Third primary radials larger than the second and about as large as the first, very tumid, pentagonal, axillary, and in three of the rays support on each upper sloping side three secondary radials, which gives to each of these rays two arms. In each ray adjoining the azygous area there is on each superior sloping side of the third primary radial a single secondary radial, which is axillary and supports on each side three tertiary radials, which gives to each of these rays four arms. There are, therefore, fourteen arms in this species. The calyx is much more protuberant at the ends of the radial series adjoining the azygous area than elsewhere, by reason of the increased number of radial plates. The arms are composed of a double series of short plates, from the commencement united by the usual zigzag suture.

There is a single long twelve sided plate in each regular interradial area. It rests between the superior sloping sides of the first primary radials, where it is concave, to conform with the other plates adjoining. It then curves over the summit of the calyx, where it is very tumid and separates the primary, secondary and tertiary radials and unites with two plates belonging to the vault. There are four plates in the azygous area. The first one is in line with the first primary radials and slightly longer and narrower than either of them. It is followed by three plates, the middle one of which is narrow within the concavity of the calyx, but gradually expands as it curves over toward the vault and becomes wider than the lateral plates at its union with the three plates belonging to the vault. The lateral plates are wide within the concavity of the calyx and very tumid where they curve over toward the vault, but become narrow and flattened where they unite with the plates of the vault.

The vault is highly convex, and interradial areas concave. There is a large, tumid plate at the apex of this vault, which is surrounded by six large, convex plates and from two to four small plates in the azygous area. In some of our specimens there are only two of these plates at the top of the azygous area, that separate it from the summit plate, as shown in figure 2, and in others there are four, which is the case in the specimen illustrated by figure 3, but they are hidden from view, in the illustration, because of the prominence of the azygous swelling. A row of large tumid plates covers each ambulacral area from the summit to the arms and there are two of these plates at the base of the arms in each of the four armed series. It would seem that the ambulacral canals are covered with large plates where they unite in each radial series. The plates in the interradial areas are flattened or concave and more or less elongated. The azygous area is very wide and bears an elongated, more or less elliptical, bulbous prominence, in the upper part, which has an elongated azygous opening. The plates covering the azygous area and bulbous prominence are polygonal, variable in size, and flattened or concave.

This species is distinguished from all others, heretofore described, by the character of the regular interradials and azygous plates, by the azygous area, and by having fourteen arms. After having examined several hundred specimens belonging to this genus, we believe that the number of arms do not vary within the proper limits of a species, and hence the number of arms may always be regarded as of specific importance. Other specific characters will always be found in the interradial and azygous plates, belonging to the calyx, but differences in the interradial plates belonging to the vault will be found in the same species. There is no increase in the number of plates belonging to the calyx, with increase of size, in the same species; but there may be an increase, in the number of plates, in the vault, within the proper limits of a species.

This magnificient species was found by Prof. A. G. Wetherby, in the Keokuk Group, in Tennessee, and is now in the collection of Wm. F. E. Gurley.

AGARICOCRINUS TUGURIUM, n. sp.

Plate III, Fig. 4, basal view; Fig. 5, summit view; Fig. 6, azygous view of the same specimen.

Species very large, subpentagonal in outline. Calyx broadly concave centrally and rounding up to the arms and having a fanciful resemblance to a hut, which suggested the specific name. The plates of the calyx are concave or flattened, and are in striking contrast with the tumid plates, in the species last described.

Basals small and entirely hidden by the column. First primary radials wider than long, a small part abruptly bent into the columnar concavity, three hexagonal, two heptagonal. Second primary radials one-fouth wider than long, quadrangular. Third primary radials very large, even larger than the first, pentagonal, axillary and in three of the rays, support on each upper sloping side three secondary radials, which gives to each of these three rays two arms. In each ray adjoining the azygous area, there is on one superior sloping side of the third primary radial, three secondary radials, and, on the other, a single secondary radial, which is axillary, and supports on each upper side two tertiary radials, which gives to each of these rays three arms. There are, therefore, twelve arms in this species. The calyx is more protuberant, at the ends of the radials adjoining the azygous area, than elsewhere, by reason of the increased number of radial plates. The arms are composed of a double series of short plates, from the commencement, united by the usual zigzag suture.

There is a single, long, twelve sided plate, in each regular interradial area. It rests between the superior sloping sides of the first primary radials, curves over the summit of the calyx separating the primary, secondary and tertiary radials, and unites with two plates belonging to the vault. There are four plates in the azygous area. The first one is, in the lower half, in line with the first primary radials, but it is more than twice as long as a primary radial and curves over the calyx so as to be visible, in a side view, as shown in figure 6. It is followed by a short plate that unites with two plates belonging to the vault. There is a plate, on each side of the first and second plate above described, that rests upon one superior sloping side of a first primary radial, is of about the same size as a regular interradial, has nine sides, and curves over and unites with two plates belonging to the vault. Each of these plates abuts one side against the primary, secondary and tertiary plates and the other against the first and second azygous plates.

The vault is subpyramidal and flattened or slightly concave in the interradial areas. There is a very large, tumid plate at the apex of the vault, which is surrounded by six large, convex plates and one narrow elongated plate, in the azygous area. At least, there is only one plate at the top of the azygous area in the specimen being described, which may be seen in figure 5. There is a single, very large, tumid plate over the lower part of three of the ambulacral areas, and two over the lower part of the other two areas. These large plates cover the ambulacral canals, where they unite, in each radial series. All other plates in the vault are smaller than those described, but they vary much in size; some are convex, others flat, and others concave. Those in the interradial areas are not numerous and are generally elongated. The azygous area is almost wholly taken up with a remarkable bulbous, elliptical prominence that bears the azygous opening. The plates in this area are rather large, generally, and conform to the surface elevations and depressions.

This species is distinguished from all others heretofore described by the characters of the regular interradials and azygous plates, by the azygous area and bulbous prominence and by having twelve arms. Many other differences might be pointed out, but we deem these characters amply sufficient. We might begin to compare it with *Agaricocrinus profundus*, by saying that the calyx is proportionally higher and the vault proportionally lower and so on, but the species are so different from each other that they never, even in fragments, can be mistaken for each other, and no light would be thrown upon them by pursuing the comparison. And so it will be found by comparing it with any other defined species.

Found by Prof. A. G. Wetherby, in the Keokuk Group, in Brown county, Kentucky, and now in the collection of Wm. F. E. Gurley.

AGARICOCRINUS ARCULA, n. sp.

Plate III, Fig. 7, basal view of a large specimen; Fig. 8, summit view of a small specimen; azygous view of the same.

Species medium size and preserving all the characters ascribed to it, in numerous specimens. Calyx deep, subconical; outline, subpentagonal. All of the plates of the calyx are flattened or concave, and conform to the outline of the calyx, none of them are convex.

Basals small, entirely hidden bv the column, that is, they form a little cup which is filled by the column, while the first primary radials rest upon the top of the cup. First primary radials rather longer than wide, a small part abruptly bent into the columnar concavity, three hexagonal, two heptagonal. Second primary radials somewhat irregular in outline, quadrangular, and fully as long as wide. Third primary radials larger than either the first or second, three hexagonal, two pentagonal, axillary, and support on each superior sloping side two secondary radials, which gives to this species ten arms. The arms are composed of a double series of short plates, from the commencement, united by the usual zigzag suture.

There are three plates in each regular interradial area. The first is an elongated octagonal plate that rests between the superior sloping sides of the first primary radials and separates the second and third primary radials and is followed by two narrow elongated plates that separate, in part, the third primary radials, and both secondary radials and unite with two plates belonging to the vault. There are seven plates, in the azygous area. The first one is in line with the first primary radials, but somewhat longer and narrower. It is followed by three plates, that separate the primary and first secondary plates, and are of nearly the same size. The third range consists of three plates, the middle one of which is the widest, that separate the second secondary radials and unite with the plates of the vault.

The vault is subpyramidal and flattened in the interradial areas. There is a large tumid plate, at the apex of the vault, which is surrounded by six large convex plates and three small plates, at the top of the azygous area. There is a single large tumid plate over the lower part of each ambulacral area. These large plates cover the ambulacral canals, where they unite, in each radial series. All other plates in the vault are smaller than those described, polygonal, vary much in size, some are convex but they are generally flat. The azygous area is covered with numerous small plates, is longitudinally convex centrally and has an azygous opening in the superior part of the central elevation.

This species is distinguished from all others heretofore described by the number and form of the regular interradials, by the number and form of the azygous plates and by having ten arms. Other differences are conspicuous when it is compared with other ten-armed species.

Found by Prof. A. G. Wetherby, in the Keokuk Group, in Tennessee, and now in the collection of Wm. F. E. Gurley.

CYLICOCRINUS (?) INDIANENSIS, n. sp.

Plate IV, Fig. 20, basal view; Fig. 21, azygous side; Fig. 22, opposite view.

There is doubt about the generic reference of this species, but, notwithstanding the wide variation from the type species, in the absence of a knowledge of the vault, we have concluded so to refer it, rather than to coin a new generic name. The calyx is broadly rounded below and slightly constricted toward the top, though somewhat semi-elliptical, in outline. Width about one and a half times the height. Plates convex and more or less nodose. Column small and round.

Basals three, equal, and forming an hexagonal disc having three re-entering angles and having a width from three to four times the diameter of the column. Each basal plate bears two spines that are directed downward around the column, and, upon the apices of which, the calyx will stand. The first primary radials are very large, a little wider than high, three hexagonal, two heptagonal. Second primary radials quadrangular and more than twice as wide as high. Third primary radials about the same size as the second, pentagonal, axillary and support on each upper sloping side the secondary radials. Our specimen preserves only one secondary radial in each series, but, as it does not show an ambulacral notch, it is believed there are two and that the second one bears the free arms. Evidently there were only ten arms in this species.

There are three plates in each regular interradial area, one large plate followed by two small ones that are bent inward and evidently unite with the plates of the vault, though none of the vault is preserved in our specimen. The first plate is larger than the second and third primary radials together, but only about two-thirds as large as a first primary radial. The first azygous plate is in line with the first primary radials, and slightly longer and narrower. It is followed by three plates in the second range and four in the third range, beyond which our specimen is not preserved.

Found in the Niagara Group, at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY PLATYCRINIDÆ.

PLATYCRINUS VASCELLUM, n. sp.

Plate II, Fig. 16, basal view; Fig. 17, azygous side view; Fig. 18, summit view of the same specimen.

Species medium size. Calyx broadly rounded below, somewhat half globular in form and about twice as wide as high. Surface covered with nodes. Sutures beveled. Column small.

The basals form a pentagonal disc, having a width equal to about three times the diameter of the column. The cicatrix for the attachment of the column slightly concave. The small basal bears three nodes and the larger basals four or five each, as they are, in part, broken, as shown in figure 16, it is not clear whether they had four or five. The calyx will stand on the points of these nodes. First radials slightly wider than high, expand upward, moderately convex toward the articulating scar, three heptagonal, two hexagonal. The articulating scar for the second radial is a little more than one-third of the width of the plate, from each side of which the plate slopes to the suture. Each plate is ornamented with nine nodes arranged as follows: Two lines of three nodes each radiate from below the middle part of the second radial to the inferior lateral angles of the plate, one node is in the middle of the lower part of the plate, and there is one near each of the superior lateral angles of the plate. The second radial is very thin, triangular, directed horizontally, axillary and supports upon its outer sloping sides the free arms. There are, therefore, ten arms in this species. The arms are small and the first plates are directed horizontally.

Interradials large, convex and each one bears a central node. Vault slightly convex and covered with rather large, polygonal, convex plates, each one of which bears a central node. The azygous orifice is submarginal, surrounded by seven plates, the larger one of which stands nearly upright on the edge of the azygous interradial.

This species is distinguished by the surface ornamentation, large, convex, nodose inter-radials, and position and character of the azygous orifice, and small, horizontally directed second radials, and ten arms.

Found by Prof. A. G. Wetherby, in the Keokuk Group, in Tennessee, and now in the collection of Wm. F. E. Gurley.

MACROSTYLOCRINUS INDIANENSIS, n. sp.

Plate III., Fig. 23, side view.

Calyx semi-elliptical in outline. Sutures beveled. Surface sculptured in longitudinal and transverse lines, depending on the shape of the plate, but not radiately sculptured from a central point on any of the plates.

Basals three, one about half the size of either of the others, and together forming a little cup, that bears a very small cicatrix at the base for the attachment of a very small column. First radials large, about as wide as high, three heptagonal and two hexagonal. Second radials very small, short, quadrangular, about three times as wide as high. Second and third radials together about half as large as the first. Third radials about the same size as the second, pentagonal, axillary, and bearing upon each upper sloping side a single secondary radial. We have three specimens belonging to this species and none of them have more than a single secondary radial and that appears to have supported an arm, though no part of an arm is preserved on either of the specimens, neither is any part of the vault. The species evidently possessed only ten arms.

The first inter-radial is a narrow, elongated plate, resting between the lateral sides of the first radials and extending as high as the third radial. It is presumed that it was followed by two small plates, but they are not preserved in either of our specimens.

This species is so different from all the species heretofore described that even a fragment of it can be distinguished, and no comparison, therefore, with either of them is necessary.

Found in the Niagara Group, at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY RHODOCRINIDÆ.

ARCHÆOCRINUS KNOXENSIS, n. sp.

Plate III, Fig. 10, basal view; Fig. 11, azygous view; Fig. 12, summit view, the matrix covers the sutures of some of the plates.

Species rather large. Calyx bowl-shaped, subpentagonal in outline, about one-half wider than high. Radial ridges not defined. Plates highly convex and each one bearing a central node and some of the largest plates bearing two or three nodes. Sutures beveled. Surface granular. Columnar cavity rather small and subpentagonal in outline.

Basals small and hidden by the column. They form a small cup which is filled with the end of the column, and on the top of which the subradials rest. Subradials large, longer than wide, abruptly bent into the columnar cavity and upward between the under sloping sides of the first radials. The azygous subradial is octagonal, the others heptagonal, by reason of three plates in the azygous area touching the subradial, while only two touch it in the other areas. The summit is not truncated in the regular areas and only minutely in the azygous area. The first primary radials are smaller than the subradials, about as high as wide; each one is heptagonal. The inferior angle is sunk in a pit formed by it and the adjacent lateral angles of the subradials. Second primary radials more than half as large as the first, three heptagonal and two hexagonal, each one wider than long. Third primary radials very small, of unequal size, generally about one-third as large as the second primary radials, one hexagonal, the others pentagonal, axillary, and support on each upper sloping side two small secondary radials. There are, therefore, ten arms in this species and ten ambulacral openings to the vault. There are no intersecondary radials.

In each regular interradial area there is a large central plate, which is surrounded in some areas by seven plates, and, in other areas, by eight plates, and above these there are three or four plates that may be said to belong to the calyx, but they graduate into the plates of the vault without any distinct line of separation. In fact, the area is continuous with the vault. The azygous interradius differs from the other areas only in being a little wider and containing a few more plates. The central plate is somewhat larger than in the other areas and slightly truncates the subradial, and is surrounded with eight other small plates. On each superior lateral side of the ring thus formed by the eight plates, there are four plates, and above these there or three or four plates that may be said to belong to the calyx, but they graduate into the plates of the vault without any line of separation.

The vault is moderately convex over the ambulacral canals and slightly depressed in the interradial areas. It is covered with rather large polygonal plates, each of which bears a central node. Part of the matrix is on the summit of our specimen so as to present the delineation of all the plates, as may be seen in the illustrations. There is a small subcentral proboscis.

This species is distinguished by its interradial areas alone from all other described species. Indeed, it is quite peculiar in many respects, and no comparison is necessary with any that has been described.

Found by Prof. A. G. Wetherby, in the Trenton Group, in Knox county, Tennessee, and now in the collection of Wm. F. E. Gurley.

GILBERTSOCRINUS GREENEI, n. sp.

Plate III, Fig. 13, basal view; Fig. 14, side view; Fig. 15, summit of the same specimen, part of the vault is broken away and two pieces are chipped from the base.

Calyx broadly truncated at the base and summit, subpentagonal in transverse section, constricted below the arms, height and width subequal. Radial ridges rounded. Spines on the first radials directed downward at an angle of forty-five degrees, and base depressed so the calyx will rest on the points of these spines. The first interradials are also spine-bearing and all other plates slightly convex. Column round and pierced by a cinque foil canal.

Basal plates depressed, anchylosed and form a pentagonal disc about two and a half times as wide as the diameter of the column. Subradials a little the largest plates in the calyx, hexagonal, without reference to any division of the basal disc, length and width nearly the same, almost wholly within the basal concavity, not visible in a side view. First radials slightly smaller than the subradials, heptagonal, a little wider than long, rest on the outer rim of the truncated base of the calyx, and each one bears a short central spine, which, by reason of the position of the plate, is directed downward at an angle of about forty-five degrees. Second primary radial smaller than the first, longer than wide, hexagonal, inferior lateral sides the longest, most convex in the central part. Third primary radials very little smaller than the second and a little less convex, length and width subequal, part of them heptagonal, others hexagonal, and support on each superior sloping side two secondary radials, and in one ray shown in our specimen there are three secondary radials. The secondary radials are subequal in size and somewhat smaller than the third primary radials. The last secondary radials bear the cicatrix for the support of the arms, at the top of which there is an ambulacral orifice. There are, therefore, ten arms and ten ambulacral openings to the vault in this species.

There are three intersecondary plates in each area, one followed by two, which unite with the plates of the vault, without any distinct line of separation. These two plates, at their inferior ends, separate the superior ends of the second secondary radials, and their superior ends separate the ambulacral orifices, and interlock with the plates of the vault.

There are only two regular interradial areas completely preserved in our specimen and each of these contains thirteen plates. The first plate is a little smaller than a first primary radial, hexagonal, rather wider than long, broadly truncates a subradial, bears a short central spine, and is followed by three plates in the second range. There are also three plates in the third range and above these there are three ranges of two plates each, the last two of which are surmounted with two plates belonging to the under side of the so-called pseudo-brachial appendages.

The vault is nearly flat, gently convex over the ambulacral areas and slightly depressed, in the interradial areas, until the depression is cut short by the so-called pseudo-ambulacral appendages. The vault is covered with small polygonal plates. The azygous opening is not preserved in our specimen. The words "pseudo-ambulacral appendages" are quite erroneous, when applied to this species or to the genus to which it properly belongs. If we now turn our attention to the vault, which is well shown in the illustration, we see the ambulacral areas, the ambulacral openings, and the plates in the intersecondary areas connecting with the vault, as the same parts may be seen in other genera. The depressions in the interradial areas are the same. In other genera we have two orifices and sometimes four, six, or eight penetrating the vault between the arms, which have been supposed by some to be ovarian apertures, and this view is supported by the established fact from numerous observations, that they are excurrent orifices. They are the same in the species under consideration, the difference being, that in this species, small plates covering these "ovarian apertures" are continued so as to cut off the interradial depressions, and present the ends of the canals upon the outer edge or beyond the outer edge of the plates of the calyx, while in other genera and species the "ovarian apertures" are confined to the plates of the vault, and open gutters lead from them across the plates to the outer margin of the plates of the calyx. The structure of these orifices we have fully defined in various species of *Dolatocrinus* and *Batocrinus*, and very clearly they are not "pseudo-ambulacral appendages" in those genera, and for the same reason, we think, they are not in the species before us.

This species is congeneric with the species first described by Hall as *Trematocrinus spinigerus* and subsequently referred by him to *Gilbertsocrinus*, and later referred to *Gilbertsocrinus* by Whitfield. It is not a *Goniasteroidocrinus*, and if belonging to any defined genus, it is to *Gilbertsocrinus*. We have no specimens belonging to the type of *Gilbertsocrinus* for comparison, and the definitions and illustrations by English authors are very obscure and unsatisfactory. It is very plain, however, that *Gilbertsocrinus* and *Goniasteroidocrinus* are distinct genera, and that our species is nearer *Gilbertsocrinus* than *Goniasteroidocrinus*. It is quite probable that *Gilbertsocrinus* is confined to the subcarboniferous rocks of Europe, and is not an American genus, and that *Gilbertsocrinus spinigerus* and the two species described in this Bulletin belong to an undefined Devonian genus. We are not willing, however, to propose a new generic name until some author shall properly define *Gilbertsocrinus* or until we may have an opportunity to examine a specimen belonging to the type species in order to be assured that two genera are, in fact, included under one name. We use the name *Gilbertsocrinus*, therefore, provisionally.

This species, when compared with *G. spinigerus*, differs, in having two plates in the second intersecondary range instead of one, in having two plates in each of the three superior ranges in the regular interradial areas instead of only one in part of them, in the form of the third primary radials, in having a spine on the first interradial plate, and in other peculiarities that distinguish species.

Found in the Hamilton Group near Charleston, Indiana, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of its discoverer, Prof. G. K. Greene, the well known collector at New Albany, Indiana.

GILBERTSOCRINUS INDIANENSIS, n. sp.

Plate III, Fig. 16, basal view of a specimen preserving some complete spines; Fig. 17, basal view of another specimen; Figs. 18 and 19, lateral views of same; Fig. 20, basal view of a small specimen probably belonging to the same species; Fig. 21, summit view of same; Fig. 22, lateral view of the same specimen with interradial plates anchylosed.

Calyx truncated at the base and summit, subpentagonal, in transverse section, broadly constricted below the arms, height and width subequal. Radial ridges angular. Very long spines on the first and second radials and also on the first interradials. Basal cavity broad and deep. Column round and pierced by a cinquefoil canal. When compared with *Gilbertsocrinus greenei*, in the above particulars, it will be found to have more angular radial ridges, longer spines, deeper basal concavity, and spines on the second radials that do not exist in that species. In the latter respect it agrees with *Gilbertsocrinus spinigerus*, but not in the other respects.

Basal plates very much depressed, anchylosed, and form a pentagonal disc, less than twice as wide as the diameter of the column. Subradials, the largest plates in the calyx, hexagonal, longer than wide, almost wholly within the basal concavity, and not visible in a side view. First radials rather smaller than the subradials, heptagonal, about as wide as long, rest on the outer rim of the truncated base of the calyx, and each one bears a long, slender, central spine, which, by reason of the position of the plate, is directed downward, at an angle of from thirty to forty-five degrees, and on the points of which the calyx may be made to stand. Second primary radials smaller than the first, longer than wide, hexagonal, inferior lateral the longest and each one bears a long central spine directed horizontally. Third primary radials less than half the size of the second, and longer than wide. This is as far as the plates are preserved in the two larger specimens, which we have illustrated, and that far they seem to agree with the smaller specimen. The interradial areas to this height appear to agree substantially with *G. greenei.* Two of the interradial areas are like the one represented in Figure 18 and three of them are like the one represented in Figure 19. From this point to the summit we will look at the small specimen and note how it differs from *G. greenei.* The plates in the intersecondary and interradial areas are anchylosed, but the intersecondary areas are proportionally longer and the interradial areas shorter, and hence, it would appear, that there are more plates in the intersecondary areas in this species than in *G. greenei,* but this is estimating on space, and if we could see the plates, their size might govern instead of space.

The vault, however, is quite different in this species from what it is in *G. greenei.* The vault is covered, in this species, by minute, almost granular convex plates, which gives it quite a different aspect. Although the specimen is much smaller, the plates are at least fifty per cent. more numerous, in this species than in that. The interradial areas are much more depressed and the ovarian canals (if it be proper to call them by that name) project much farther beyond the margin of the calyx, in this species than they do in *G. greenei,* and they are proportionally larger, and occupy more space between the ambulacral openings. The vault of our specimen preserves part of the azygous apertures which is located on an ovate elevation. The vault of this species is altogether different from that in *Gilbertsocrinus spinigerus* so that no comparison with it is necessary.

Found in the Hamilton group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY TAXOCRINIDÆ.

ONYCHOCRINUS PULASKIENSIS, n. sp.

Plate IV, Fig. 1, view opposite the azygous side, with four and one-third inches of the column; Fig. 2, azygous side of the same specimen without the column, the specimen is compressed antero-posteriorly which makes the head appear too wide.

Species large and robust. Calyx very low, saucer-shaped. Plates finely granular. Sutures distinct. Column very large and within sixth-tenths of an inch of the calyx, tapering and composed of very thin plates, but below that composed of thick plates, some thicker than others and projecting beyond them, but not regularly alternating at all times, though becoming more regular in this respect an inch or two below the calyx. It is somewhat elliptical and pierced by a long-rayed stellate canal.

Basals covered by the column. Subradials very short and superior angles obtuse. Primary radials four in each ray and differing but little in size, the first and fourth are the longer and subequal. Each one is wider than high and the third one is nearly twice as wide as high. The sutures are transverse. The fourth plate in each ray is axillary and supports the second series of radials, the plates of which are very long, quite as long as those in the first series, excepting the first and fourth. In one of the rays of our specimen, seven of the plates are preserved as shown in figure 1, and a small armlet is thrown off from the fifth plate.

One interradial is preserved in three of the areas, and there may not have been any more, except in the azygous area, where there were evidently several small plates, in addition to the one preserved.

There is no described species for which this one might be mistaken and hence there is no necessity for drawing comparisons.

Found by Prof. A. G. Wetherby in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

TAXOCRINUS WETHERBYI, n. sp.

Plate IV, Fig. 3, basal view, azygous side down; Fig. 4, view opposite the azygous side; Fig. 5, summit view of same specimen, having the ends of the arms obscured by the matrix.

This species is founded upon two specimens presenting the same general characters, shown by the illustrations, and while the first impression may be, that they are compressed longitudinally, yet a close examination does not reveal any displaced plates, and the rugular infolding of the arms leads to the conclusion, that they are very little, if any, out of their normal condition. That being true, the calyx is very short and broadly expanded. The radial ridges are rounded and the interradial areas flattened or depressed, giving a pentagonal outline to the calyx as seen from below, but a rounded outline when the infolded arms are seen from above. The surface of the plates is finely granular and the sutures are distinct.

Basals covered by the column. Subradials very short and superior angles obtuse. Primary radials four, in each ray, broadly rounded and differing very little in size. The sutures are transverse without any overlapping. The fourth plate in each ray is axillary and supports upon each superior sloping side two secondary radials. The secondary radials are only a little smaller than the primary. The second secondary radials are axillary and the proximal sides, in each radial series, support two tertiary radials, the last of which are axillary and support a quaternary series of plates above which rays again divide, the distal sides support four tertiary radials the last of which are axillary and above which the radial rays again divide. The above method of division is without variation, in the specimen, illustrated, except in one instance, where a third tertiary radial is axillary instead of the second plate. In the other specimen there are more bifurcations on the third tertiary radial in the distal series than there are on the fourth. If there are any more divisions than those mentioned, they are covered by the matrix. By the divisions above mentioned there are fourteen arms to each ray or seventy arms in the species, and the differences in the rays commence in the tertiary radials, above which, radial differences are not of specific importance.

The plates, in the regular interradial areas, are of almost uniform size. In the best preserved areas there is one plate in the first range, two in the second, three in the third and four in the fourth, but in one of the areas there are only three plates, in the fourth range. The fourth range curves in toward the vault and it would seem, therefore, to be the last range properly belonging to the calyx. There is one plate in each intersecondary radial area, which will necessarily give the vault a pentagonal outline, notwithstanding its rounded appearance when we look at the infolded arms. The only plates preserved in the azygous area belong to the small column of hexagonal plates on one side of the area. An examination of the primary radial plates and appearance of the specimens lead to the conclusion that this area is depressed and quite different from the other areas in all respects.

This species is so different from all others that no comparison with any of them is necessary to distinguish it, beside it is the first time a species belonging to this genus has been described from rocks of the age of the Kaskaskia Group.

Found by Prof. A. G. Wetherby, in whose honor we have named the species, in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

EMPEROCRINUS, n. gen.

[Ety. *emperos*, deformed; *krinon*, lily.]

This genus is proposed to receive species that have three basals, five subradials and regular interradials, but do not belong to any of the described genera in the family *Taxocrinidæ.* Basals three, of unequal size. Subradials five, three heptagonal, two hexagonal. Primary radials two in each ray. Regular interradials one or more in each area. Azygous plates two or more. The radial system is altogether different from that belonging to any other genus, in the family Taxocrinidæ, but the whole structure is fundamentally different, in all other respects, from all other families of crinoids and hence the genus is placed here, at least, provisionally. Type *Emperocrinus indianensis.*

EMPEROCRINUS INDIANENSIS, n. sp.

Plate IV, Fig. 16, basal view; Fig. 17, azygous side view of the same specimen, the plates on the vault are covered with the matrix.

Calyx very low, saucer-shaped, truncated at the base or flattened over the basal and subradial area, subpentagonal in outline. Plates smooth or granular. Column round. Columnar canal cinque foil.

Basals consist of two plates of equal size and one much smaller; together they form a flat pentagonal disc, which is almost covered by the end of the column. Subradials are of about equal size, nearly as long as wide, three heptagonal, two hexagonal. First primary radials larger than the subradials, pentagonal, having two inferior sloping sides that rest between the sloping sides of the subradials, abutting laterally upon the interradials and being truncated entirely across the superior end. Second primary radials of almost exactly the same size as the first, but a little wider and turn the sloping sides in the opposite direction, pentagonal, axillary, and support on the superior sloping sides two secondary radials. This gives to the species ten arms and ten ambulacral openings to the vault. The arms are directed almost horizontally, but no part of them is preserved in our specimen.

There are three regular interradials in each area. The first one truncates a subradial and separates the first and second primary radials. It is followed by two plates that separate the first secondary radials and curve over and unite with the plates of the vault. The azygous area is wider than the regular areas and contains four plates. The first one is larger than a first regular interradial, truncates a subradial and separates the first and second primary radials. It is followed by three plates in the second range that unite with the plates of the vault.

The vault in our specimen is covered with the lime stone matrix, so that the plates cannot be distinguished.

Found in the Niagara Group at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY PTEROTOCRINIDÆ.

PTEROTOCRINUS WETHERBYI, n. sp.

Plate IV, Fig. 6, azygous side of an almost perfect specimen except the interbrachial plates are broken off; Fig. 7, basal view of another specimen, azygous side down, and having the interbrachials broken: Fig. 8, summit view of the same showing the small plates at the apex of the vault; Fig. 9, view of another specimen with the arms broken off so as to show the furrowed vault and sides of interbrachials that are somewhat broken.

Species medium size. Calyx low, saucer-shaped, between two and three times as wide as high, broadly constricted in the region of the primary radials. Surface finely granular. Column small, round, deeply inserted and having a very minute central canal.

Basals two, each pentagonal, by reason of being slightly truncated, at one angle, by the azygous plate, and together, forming a low, subpentagonal cup, notched at one angle, by the azygous plate, and having a deep central depression for the insertion of the column, which has a diameter equal to about one-fourth the width of the basal pentagon. The columnar cavity is funnel-shaped and has a rather sharp or angular rim. First primary radials of unequal size and by reason of the truncation of two of them by the azygous plate very unlike in outline. They are from three to four times as wide as long, three heptagonal and two hexagonal. Second primary radials small triangular plates resting on the middle part of the straight upper face of the first radials and each occupying from one-fourth to one-fifth of the width of the superior face of a first radial and supporting on each sloping lateral side part of a first secondary radial. There is only a single secondary radial in each series and it is more than twice as wide as high, irregularly pentagonal, and rests its part upon the first primary radial but rarely if ever extends to the superior lateral angle of it, and bears upon the superior side a tertiary series and upon the superior lateral side part of another tertiary series of plates. Prof. Meek called the tertiary radials in this genus brachials, but we prefer to call them the tertiary radials, because they rest, in part, upon the first primary radials as well as upon the secondary radials and constitute part of the calyx. In some rays there are three tertiary radials entering into and forming part of the calyx and in other rays there are four, and these are followed by the free arms. In the series resting in part on the first primary radials there are usually four tertiary radials, and in the series resting upon the secondary radials there are three tertiary radials. The first four or five plates of the free arms are very short and transverse and above these the arms are composed of a double series of interlocking plates. Each plate bears a small pinnule. The arms gradually taper and are depressed, convex or somewhat flattened externally. There are twenty arms, four between interradials, and they infold at the top leaving the apex of the vault uncovered and the interradials extended above them.

The azygous plate is quadrangular, the shorter and lower lateral sides rest in a notch at the angle of the pentagon formed by the basal plates, while the longer convex sides truncate the inferior lateral angles of the two first primary radials. The interradials, or interbrachials, as they are usually called, consist of five plates which divide the arms into clusters of four each. They are leaf-like expansions, each of which rests in a broad, deep, angular furrow in the vault, and projects half its width beyond and above the arms, where it is thin and knife-like. The thicker part of each plate is within the outer margin of the infolded arms, and the shape of the furrow into which the interradial is inserted may be seen in figure 9, though a small piece of the interradial is remaining in the lower part of the furrow.

The vault is pyramidal and fluted or furrowed and covered with large plates. In the lower part of the vault the plates are sharply angular in the middle part and separated by a suture in the bottom of the furrows, but higher up there are two angular ridges on a plate, separated by a flattened space, at the bottom of the furrow, without a suture. This arrangement breaks the continuation of the sutures and of course strengthens the vault. The apex of the vault is small and covered with quite small plates. A *Platyceras* or other Gastropod could not attach to this summit on account of the projecting knife-like edges of the interradials.

This species is so different from all others that no comparison with any of them is necessary to distinguish it.

Found by Prof. A. G. Wetherby, in whose honor we have proposed the specific name, in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY POTERIOCRINIDÆ.

POTERIOCRINUS VAGULUS, n. sp.

Plate 4, Fig. 10, azygous side on the left; Fig. 11, opposite view of same specimen.

Species medium size, robust, arms coarse, calyx obconoidal, truncated below, about as long as wide; sutures distinct; surface granular. Column large, tapering from the calyx, and composed of moderately thick plates. Columnar canal small.

Basals rather large, longer than wide and forming an obpyramidal cup. Superior angles obtuse. Subradials rather longer than wide, four hexagonal, one heptagonal. First radials wider than long and truncated the entire width above. Second radials shorter than the first and truncated the entire width above, at which point the five arms seem to have become free without the usual gaping sutures or other special provisions for a free movement. Above the second radials the arms continue without any apparent decrease in diameter to the first and probably the only bifurcation. This takes place on the eighth plate in the arm on the left of the azygous area, on the sixth plate in one of the lateral arms and in the arm opposite the azygous area the eighth plate is cuneiform, not axillary, and beyond this it is not preserved in our specimen. The other two arms are not preserved in our specimen as high as the place of bifurcation. Probably, the arm opposite the azygous area remains single and the two arms not preserved divide as in the first two above described. Two of the arms are preserved as high as the twelfth plate above the first bifurcation without any evidence of another division. It, therefore, appears that only four arms divide and that this species possesses five arms in the lower part and nine in the upper part. The arms are composed of short, cuneiform plates, and are round externally, showing three-fourths of the circumferance, which necessarily leaves the arm furrows very narrow.

The first azygous plate is large, longer than wide, hexagonal, truncates a subradial, and extends as high as the second radial. Beyond this neither the azygous area or the proboscis is preserved, in our specimen, but there are numerous scattering plates belonging to the proboscis which are transversely serrated.

This species is so different from all others that have been described that no comparison is necessary with any of them to distinguish it.

Found by Prof. A. G. Wetherby, in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS PULASKIENSIS, n. sp.

Plate 4, Fig. 12, azygous side; Fig. 13, opposite view.

Species below medium size, subcylindrical, constricted above the calyx, truncated below and slowly tapering at the superior end. Calyx very low, broadly truncated and depressed below. Surface smooth or finely granular. Column very small and round.

Basals deeply sunken so as to be hidden by the column. Subradials longer than wide, and curve into the basal concavity and upward at about the middle part, which is gently rounded, so as to show the superior ends in a side view. First radials about one and a half times as wide as high, pentagonal, truncated the entire width above, and separated from the second plates, which belong to the free arms by a gaping suture. Second plates or first arm plates longer than the first radials, nearly as high as wide, constricted in the middle part, and truncated the entire width above in a line more or less inclined for the support of the second arm plate, which is short and cuneiform. There are, therefore, only five arms in this species. The arms are robust, subfusiform and composed of a single series of short, cuneiform plates. The pinnules are short and strong.

The first azygous plate is much smaller than the second, and is embraced between a subradial and the first radial on the right, without extending to the second subradial as is usual in this genus. The second azygous plate is longer than wide, truncates a subradial and curves in toward the vault so as to extend very slightly beyond the single first radial on the left. The third azygous plate rests upon the first and curves in upon the vault at the top of the first radial. The fourth azygous plate truncates the second. What appears to be part of the top of the proboscis may be seen at the summit of our specimen, but it is too imperfect for description.

This small species is peculiar and so different from all heretofore described that the five arms alone will always identify it.

Found by Prof. A. G. Wetherby in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS DURABILIS, n. sp.

Plate 4, Fig. 14, azygous side; Fig. 15, opposite view.

This species is founded upon two specimens, in about an equal state of preservation, but the one illustrated is one-half larger than the other. The species is small and short, subovate in outline, being truncated at the base, subfusiform in the middle, and tapering toward the summit.

Calyx very low, rounded and depressed below. Plates convex; sutures distinct. Surface granular. Column small and round.

Basals sunken so as to be hidden by the column. Subradials longer than wide but hardly visible in a side view. First radials about one and a half times as wide as high, pentagonal, truncated the entire width above, and separated from the second radials by a gaping suture. Second radials longer and larger than the first, about one-half wider than high, rounded externally, pentagonal, and support upon each superior sloping side the secondary radials or free arms. In each ray adjoining the azygous area, there is a single, long, secondary plate, on the distal side of the second primary plate, that is axillary and supports an arm upon each superior side, while an arm arises directly from the proximal side of each second primary radial. This arrangement gives to each of these rays three arms. The lateral rays are constructed in the same way and each bears three arms. In the ray opposite the azygous area there are only two arms which are supported on the upper sloping sides of the second primary radial. The species, therefore, has fourteen arms. The arms are short, small, regularly taper, and are composed of small cuneiform plates. The pinnules are short.

The first azygous plate is narrow, elongated, pentagonal, rests between two subradials and the first radial on the right, and abuts upon the second and third interradials. The second azygous plate is larger than the first, hexagonal, truncates a subradial, and adjoins the first radial and part of the second radial on the left, and the first and third azygous plates on the right, and is truncated by the fourth azygous plate. The third azygous plate is shorter than the second, hexagonal, truncates the first azygous plate, and adjoins the first and second radials on the right, and the second and third azygous plates on the left, and supports the fifth azygous plate. The fourth azygous plate extends slightly above the second radial on the left, and the fifth azygous plate somewhat more above the second radial on the right, and the alternate arrangement of the plates continues until the area is lost in the proboscis.

This species is distinguished by its short ovate form and by having fourteen arms as well as by less important characters.

Found by Prof. A. G. Wetherby, in the Kaskaskia Group in Pulaski County, Kentucky, and now in the collection of Wm. F. E. Gurley.

BARYCRINUS WASHINGTONENSIS, n. sp.

Plate IV, Fig. 18, azygous side, there is one too many brachials in the ray on the left; Fig. 19, opposite view.

Species robust, medium size. Calyx higher upon the azygous side than upon the other, somewhat bowl-shaped, one-half wider than high on the azygous side, and nearly twice as wide as high on the opposite side. Plates thick, very tumid in the central part, and having a broadly rounded ridge extending to each adjoining plate, thus giving the calyx a radiately sculptured aspect without depressions at the angles of the plates.

Basal plates form a pentagonal disc nearly one-half wider than the diameter of the column, and show the radiating surface ridges even on the narrow area surrounding the column. Subradials large, somewhat unequal in size, about as wide as high, four hexagonal, one heptagonal. First radials of unequal size, much wider than high. Facets for the reception of the second radials concave, directed somewhat outward and not extending quite to the superior lateral angles. Second radials very thin and rounded externally. Third radials a little longer than the second, axillary, and support upon each upper sloping side strong arms. The second and third radials above described are usually called brachials. The ray on the left of figure 13 there shows thres brachials, but the artist mistook a slight displacement filled with stone for a plate, and there should have been only two brachials in the figure. There are, therefore, ten arms in this species, two from each ray. They are composed of long, rounded cuneiform plates that bear numerous armlets. In the lower part of the arms every third plate bears an armlet, but higher up every second or alternate plate bears an armlet. The armlets are composed of short plates and look like small arms.

First azygous plate is quadrangular, broadly truncated, a subradial separates two first radials and rapidly expands to the summit of the calyx. The other azygous plates, vault and proboscis are not preserved in our specimen.

This species is readily distinguished from *B. formosus* by the surface ornamentation and absence of pits at the angles of the plates, as well as by comparison of the specific details. It is still farther removed from *Barycrinus blairi* and *Barycrinus boonvillensis*, and need not be compared with any other described species, as there is none for which it might be mistaken.

Found in the Keokuk Group in Washington County, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS CORPOROSUS, n. sp.

Plate V, Fig. 1, basal view; Fig. 2, summit view, the sutures between the plates being too obscure to illustrate; Fig. 3, azygous side of the same specimen.

Species large. Calyx subhemispheroidal, broadly truncated, at the base, and constricted below the arm bases. Radial ridges mere rounded elevations across the plates which are interrupted by central nodes. Surface ornamented with numerous radiating ridges that do not coalesce in the centers of the plates. Column large, round and having a remarkably large, cinque-foil canal.

Basal plates hidden by the column and a rounded rim that surrounds it, on the basals and at the commencement of the first primary radials. First primary radials wider than long and of unequal size, two of them, on the azygous side, being larger than the others, as shown in the upper part of figure 1. Second primary radials large, about one-half wider than long, quadrangular, sides nearly parallel. Third primary radials rather longer and wider than the second, pentagonal, axillary and bear upon each superior sloping side a single secondary radial. The secondary radials are of unequal size, part heptagonal and part hexagonal, and bear upon each superior sloping side four tertiary radials. The first tertiary radials are moderately large, the others are quite short. There are, therefore, twenty arms and twenty ambulacral openings to the vault in this species. There are no intersecondary or intertertiary plates.

The first interradials are very large plates and have nine sides. They are followed in the second range, by a single plate, which is about half or less than half the size of the first. In some of the areas, there are two plates and in others three plates, in the third range, that connect with the plates of the vault. The azygous area is wider than either of the regular areas and the first plate is the largest in the calyx and has eleven sides. The additional sides are produced by abutting against the first tertiary radials, which the first plate in the regular areas does not reach. It is followed in the second range by a single plate larger than the second plate in the regular areas. There are three plates in the third range that unite with the plates of the vault.

The vault is moderately convex over the ambulacral areas and depressed in the interradial areas, most depressed in the azygous area. Most of the sutures between the plates of the vault are destroyed, in our specimen, but where the plates can be distinguished, they are large. The proboscis seems to be complete, in our specimen, and, as may be seen in the illustrations, the plates are merely elevated around a subcentral azygous opening. There is a minute orifice on each side of each arm base, which we suppose represent the ovarian apertures, but they are so small for so large a specimen that we suppose the silicification has partly closed them. They are not down in the interradial areas, as in other species, but are differently located.

The general form, surface ornamentation, interradial and azygous areas and twenty arms will readily distinguish this species from all others that have been described. It is a marked and beautiful species.

Found in the Hamilton Group, at Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS HAMMELLI, n. sp.

Plate V, Fig. 4, basal view, the rim around the cavity is a little out of shape in the specimen, and is subpentagonal instead of hexagonal; Fig. 5, side view; Fig. 6, summit view of the same specimen.

Species medium size. The specimen illustrated is the smallest of six before us, but the largest is not more than one-fourth more in diameter. Calyx low, basin-shaped, specially expanded at the arms, from three and a half to four and a half times as wide as high, deeply and broadly concave below, the depression extending to the third radials. Columnar pit funnel-shaped, and bounded externally by a pentagonal, raised ridge running from a tubercle in the middle of the superior part of each first radial plate to the next adjoining. Radial ridges merely sharp elevations crossing the plates and interrupted by sharp nodes at the center of each plate. Surface radiately sculptured. Column round, inserted into the cup formed by the basal plates, and having a cinque. Foil columnar canal.

Basal plates form a round cup so deeply inserted in the calyx that it rises, in some specimens, higher than the calyx, and ends in the cavity of the vault. The mouth of the cup is one-third wider than the diameter of the column. First primary radials as wide as high, smooth below the pentagonal rim and tubercles from which the radial ridges arise, slightly sculptured above. Second primary redials twice as wide as high, slightly expanding above and quadrangular. Third primary radials expanding upward to the lateral angles, longer than the second, pentagonal, and supporting, in one ray upon each upper sloping side, a single secondary radial, which is axillary, and supports upon each upper sloping side two tertiary radials, which gives to this ray four arms. In each of the other four rays the third primary radial bears upon one upper sloping side three secondary radials, and upon the other a single secondary radial, which is axillary and bears upon each upper sloping side two tertiary radials, which gives to each of these rays three arms. There are, therefore, sixteen arms and sixteen ambulacral openings to the vault in this species.

The first regular interradials are elongated, nine-sided plates, peculiarly sculptured, by having one deep longitudinal furrow in the upper part. They are followed in the second range by a single plate, and above this there are two small plates that unite with the plates of the vault. The azygous area is a little larger than a regular interradial area and the plates are larger, otherwise it appears to be the same.

The vault is convex, most tumid on the azygous side, and bears a subcentral proboscis. The plates are large and most elongated in the interradial areas. The proboscis is evidently nearly complete in the specimen illustrated. It may have had another small row of plates at the top surrounding the azygous orifice. There are two elongated "ovarian apertures" with furrows prolonged across the top of the calyx in each interradial area, and two separating the arms in each of the five rays, which gives to this species twenty of these apertures. They are large and in striking contrast with the small ones in *Dolatocrinus corporosus*, shown in figure 2.

This species is distinguished by its general form, surface ornamentation and sixteen arms.

Found in the Hamilton Group at Charlestown, Indiana, and now in the collection of J. F. Hammell at Madison, Indiana, in whose honor we have proposed the specific name, and it is also in the collection of Wm. F. E. Gurley.

DOLATOCRINUS VASCULUM, n. sp.

Plate V, Fig. 7, basal view; Fig. 8, summit view, part of the vault broken away and showing the columnar canal at the end of the basal plates; Fig. 9, azygous side view.

Species large. Calyx broadly truncated and concave below, the concavity embracing the first primary radials, and subcylindrical above. All the plates are ventricose or subspinous and finely furrowed, radiately toward the margins. The surface ornamentation resembles that on *Dolatocrinus amplus*, but is more delicate, and the nodes more pointed.

Basals deeply sunken in the concavity and forming a pentagonal rim nearly twice as wide as the diameter of the column. First primary radials wider than long and each having a transverse obtuse node on the superior third. The two on the azygous side are the larger. Second primary radials quadrangular, about twice as wide as high and each bearing a transverse central node.

Third primary radials expand to the superior lateral angles, longer than the second, wider than high, pentagonal, axillary, and bear upon each superior sloping side in three of the rays a single secondary radial, which is axillary and bears upon each upper sloping side four tertiary radials. This gives to each of these rays four arms. In the two rays opposite the azygous area on one of the superior sides of each of the third primary radials there are four secondary radials, and on the other a single secondary radial, which is axillary and bears upon each upper sloping side four tertiary radials, which gives to each of these two rays three arms. There are, therefore, eighteen arms in this species and eighteen ambulacral openings to the vault.

The first interradial is very large, has nine sides and is broadly truncated for the second interradial. The second interradial is less than half as large as the first. In three of the areas it is followed by two plates in the third range and one in the fourth, and in one of the areas, by a single plate in the third range and two in the fourth. The azygous area is a little larger than the others, has one plate in the first range, one in the second, three in the third and two in the fourth.

The vault is convex and moderately depressed in the interradial areas. The sutures are not shown in our specimen, and part of the vault is not preserved. There are two "ovarian apertures" between each of the arms which gives to the species thirty-six of these orifices. Those in the interradial areas are evidently larger than the others.

This species is distinguished by its surface ornamentation, interradial and azygous plates, and by having eighteen arms. These characters will readily separate it from all others that have been described.

Found in the Hamilton Group, at Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS EXORNATUS, n. sp.

Plate V, Fig. 10, basal view; Fig. 11, azygous side on the left; Fig. 12, summit view.

Species below medium size. Calyx truncated below and expanding to the arm, giving it a bowl shape. Radial ridges rounded and composed almost wholly of elongated nodes in the central part of the plates. The surface of the plates is radiately sculptured in fascicles of fine lines from the central nodes, which makes the ornamentation complicated and beautiful. Column large, round, and has a large cinque-foil canal.

Basals form a flat, pentagonal disc only a little larger than the diameter of the column. First primary radials wider than long, and the calyx will rest upon the central nodes. Second primary radials about one-half wider than long, quadrangular. Third primary radials, expand to the superior lateral angles, a little wider than long, pentagonal, axillary, and bear upon each superior sloping side, in four of the rays a single secondary radial, which is axillary and bears upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. In one of the lateral rays, one of the superior sides of the third primary radial bears three secondary radials, and the other a single secondary radial, which is axillary and bears upon each upper sloping side two tertiary radials which gives to this ray three arms. There are, therefore, nineteen arms in this species and nineteen ambulacral openings to the vault.

The first interradials are the largest plates in the calyx and are followed by a single plate except in the azygous area where there are two.

The vault is convex over the ambulacral areas and sharply depressed in the interradial areas, and bears a subcentral azygous opening but slightly elevated above the central part of the vault. Only a few of the sutures could be distinguished, and they are shown, in the illustration in the azygous interradial depression.

This is a very beautiful species and will be readily recognized by its general form, surface ornamentation and nineteen arms.

Found in the Hamilton Group, in Charlestown, Indiana, and from the collection of Wm. F. E. Gurley.

DOLATOCRINUS PULCHELLUS, n. sp.

Plate 5, Fig. 13, basal view; Fig. 14, side view; Fig. 15, summit view.

Species below medium size. Calyx bowl-shaped, slightly contracted below the arms, truncated below and having a funnel-shaped basal concavity. Radial ridges small, sharply angular.

Each plate bears a long central node or spine, from the base of which, small lines radiate to the adjacent plates. Column small, round, and inserted in the cup formed by the basal plates.

Basal plates form the lower part of the funnel-shaped basal concavity, and at the top have a diameter one-half greater than the diameter of the column. First primary radials wider than long, and bear a ridge extending from the superior middle part of one to the superior middle part of the adjacent ones so as to form a pentagonal rim to the funnel-shaped basal concavity and on which the calyx will rest. The radial ridges arise from the angles of this pentagon. Second primary radials a little wider than high, quadrangular, sides parallel. Third primary radials about the same size as the second, pentagonal, axillary and support on each upper sloping side two tertiary radials. This gives to the species ten arms, which are composed of a single series of plates.

The first interradials are the largest plates in the body. They are followed by a single plate in each area; about one-third as large as the first, which unites with two plates belonging to the vault. In the azygous interradius the second plate unites with three plates belonging to the vault, which is the only difference between the interradial areas.

The vault is convex over the ambulacral furrows and abruptly depressed in the interradial areas, and bears a short central probosis. The vault is covered by two circles of large plates, the inner circle has seven plates, and within it there is an extra plate and then four plates stand upright and form the probosis which bears the azygous opening. There is an "ovarian aperture" on each side of the base of each arm, or twenty of these orifices in this species. It will be noticed that, in some species, these apertures are in the interradial areas, at some distance from the arms, while in this and some other species, they are not in the interradial depressions, but elevated and close to the ambulacral openings.

This species is most nearly related to *Dolatocrinus bulbaceus*, but differs in the general form and surface ornamentation. This species has an azygous side and "ovarian apertures," while that species has neither. Four specimens belonging to this species possess the same characters, and differ only, in the fact, that the nodes or spines on some specimens are longer than on others.

The smallest specimen has only two-thirds the diameter of the one illustrated, and the largest specimen has a diameter one-fifth greater than the one illustrated.

Found in the Hamilton Group, at Charlestown, Indiana, and from the collection of Wm. F. E. Gurley.

DOLATOCRINUS BELLULUS, n. sp.

Plate V, Fig. 16, basal view; Fig. 17, azygous, side view; Fig. 18, summit view.

Species above medium size. Calyx hemisperical, broadly truncated below. Radial ridges consist of small round ridges crossing the central part of the plates, and interrupted by prominent nodes in the center of each plate. Nodes larger and more or less transverse on the interradials. Surface ornamented by fascicles of lines radiating from the central nodes. Column large, round, and bearing a large cinque-foil columnar canal.

Basal plates almost covered by the column, and bearing a small circular ridge around the facet for the attachment of the column. First primary radials wider than long, the two on the azygous side being larger than the others. Second primary radials about one-half wider than long, quadrangular. Third primary radials expand to the superior lateral angles, longer than the second, pentagonal, axillary, and in two of the rays each bears upon each superior sloping side a single secondary radial, which is axillary, and bears upon each superior sloping side two tertiary radials, which gives to each of these rays four arms. These two rays adjoin the azygous area. In each of the other three rays the third primary radial bears upon one sloping side three secondary radials, and upon the other one secondary radial, which is axillary and supports upon each upper sloping side two tertiary radials. This arrangement gives to each of these rays three arms. There are, therefore, seventeen arms and seventeen ambulacral openings to the vault in this species.

The azygous area is like the others except a little larger. The first interradials are the largest plates in the calyx, have nine sides and are broadly truncated above for the second interradials. The second interradials are about half as large as the first, and are followed by a single plate in the third range, which unites with plates belonging to the vault.

The vault is convex, bears a small central proboscis, and is substantially covered by three circles of large plates. Some of the sutures are anchylosed in the larger circle of plates, and hence they are not shown in the illustration. There are seven plates in the middle circle, and five at the base of the short central proboscis that contains the azygous opening. The surface of the plates is destroyed, but a node may be seen on each plate over the junction of the ambulacral canals. There is a small "ovarian aperture" close to each side of each ambulacral opening, which gives to this species thirty-four of these openings.

This species is readily distinguished from all others by its general form, surface ornamentation, and seventeen arms.

Found in the Hamilton Group, at Charlestown, Indiana, and from the collection of Wm. F. E. Gurley.

FAMILY CARYOCRINIDÆ.

FAMILY STRIBALOCYSTIDÆ. (?)

STRIBALOCYSTITES SPHÆROIDALIS, n. sp.

Plate V, Fig. 19, anterior side; Fig. 20, basal view, plates injured a little where the column attached; Fig. 21, summit view.

Body broadly obovate and expanded into an obtuse rim below the summit. Surface of the plates granular, those on the vault convex. Sutures beveled.

Basals four, of unequal size, and forming an irregularly expanded cup with an hexagonal summit, and slightly re-entering angles at the sutures. Second series of plates expand to the upper third, where they are tumid and abruptly bent over toward the summit, two pentagonal, two hexagonal and two heptagonal. The heptagonal plates are the larger plates in this series. There are eight plates in the third series, of unequal size, and not in line by reason of curving over the large heptagonal plates in the second series. They are slightly convex and directed toward the summit of the body. Two of them adjoin the mouth which is surrounded by four plates.

The entire summit is covered by seven plats, four of the larger of which occupy the central part of the summit, and there is one minute plate on one side of these and two small plates on the other side. There are four orifices on the summit, one of which is as large as the mouth, and directly back of it, and surrounded by four plates, two of which belong to the third series of plates. The other two are smaller and each surrounded by three plates, the smallest passes between plates belonging to the summit, and the other is at an angle of two plates in the third range. One of the summit plates adjoining the mouth bears a prominent node.

This species is so distinct from either of the others in form and surface ornamentation and in the summit plates that no comparison with either is necessary to distinguish it. It will be observed, that the summit plates and orifices differ greatly in this genus, which reduces them to matters of specific importance only, The number of plates in each range below the summit agree with those in *Caryocrinus*. The pores in *Caryocrinus* may be of generic importance, but it is not likely that they are of family importance. Considering the fact that within the range of a genus the species vary among Cystideans more than elsewhere, and allowing like latitude, in the classification of the genera into families, we may place the genus *Stribalocystites* in the family *Caryocrinidæ*. This view is strengthened by the fact that all the forms are from the same group of rocks.

Found in the Niagara Group, at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

CARYOCRINUS KENTUCKIENSIS, n. sp.

Plate V, Fig. 22, anterior side; Fig. 23, posterio-lateral side; Fig. 24, summit view.

Species small, subelliptical longitudinally. Plates more or less convex, and bearing a few very small pores. The pores are so small that they can only be seen by the aid of a magnifier, and hence are not shown in the illustrations. The surface of the plates is sculptured, but our specimen does not preserve these markings, so as to describe them. The sutures are beveled. The body is not constricted below the arms, and is only truncated below to the extent of the diameter of the column.

Basals form a low subhexagonal cup with a hexagonal summit, and slightly re-entering angles at the sutures. The base is concave for the attachment of the column, and bears a round orifice for the columnar canal. The plates in the second range are longer than wide, and stand nearly upright, two pentagonal, two hexagonal and two heptagonal. The plates in the third range are about half the size of those in the second, and form an irregular range. They are of unequal size and shape, and surround an elongated, irregular, convex summit.

The summit is covered by eighteen plates, fifteen of which are quite small and some of them minute. There are six small openings surrounding the summit beside the mouth. They are supposed to represent the places for the attachment of the arms, and adjoin the plates in the third range except one which seems to be separated by a minute plate. The arm openings are in three pairs. The mouth is surrounded by four plates, one of which belongs to the third range. It will, therefore, be observed that the summit is covered with a number of small plates which are in no manner connected with the orifices, and which preserve no definite order of arrangement. The central one is surrounded with seven plates, and the other ten plates have no order of arrangement, as may be seen on figure 24.

This species is so different from all others heretofore described that no comparison is necessary with any of them. It furnishes another illustration of the great diversity of forms belonging to a single genus among the Cystideans.

Found in the Niagara Group, at Louisville, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY PLEUROCYSTIDÆ.

PLEUROCYSTITES MERCERENSIS, n. sp.

Plate V, Fig. 25, dorsal view slightly broken at the anterior end; Fig. 26, basal view of same.

Body irregularly subovate, and irregularly concavo-convex. There are three plates on the dorsal side that do not extend to the margin; each of these at the distal sides bears a pectinated rhomb. The two anterior ones have the rhombs located near the superior lateral margins, and the posterior one has the rhomb near the column. The left anterior rhomb is the largest. They are all somewhat elongate ovate, and have their longer diameters directed toward a central point between them, and they are striated longitudinally so that the striæ are also directed in the same way. The plates are radiately sculptured from the rhombs, but most of the striæ are destroyed on our specimen. All other plates on the dorsal side curve over and cover part of the ventral side. The ventral side is concave, and possesses a large oval space covered with very numerous minute plates. The column is elliptical, and has its shorter diameter equal to the greatest thickness of the body.

This species has one plate less in the first range than there is in *P. squamosus*, the species to which it would seem to be the nearest. The rhombs are different in form from those belonging to other species, and have their longer axes directed differently. There are minor differences that will distinguish it from other species also, and the general form will probably be sufficient in all cases. We have used the family name *Pleurocystidæ* provisionally, without defining it, because this genus cannot belong to the *Lepadocrinidæ*, where it has been placed heretofore. The family relations among Cystideans are not well understood.

Found by Prof. A. G. Wetherby, in the Trenton Group, in Mercer County, Kentucky, and now in the collection of Wm. F. E. Gurley.

ORDER CYCLOCYSTOIDEA.

FAMILY CYCLOCYSTOIDIDÆ.

CYCLOCYSTOIDES ILLINOISENSIS, n. sp.

Plate V, Fig. 27, outer rim of a part of a specimen; Fig. 28, outer rim of part of another specimen.

This species is large and the outer rim is composed of a great many plates. One of our specimens which does not appear to be more than one-third of a circle, has nine plates. The other specimen, which does not appear to be much, if any, more than one-half of the circle, has thirteen plates. The inference is that a complete specimen will have from twenty-four to thirty plates. The outer part or margin of the rim bears four or five rows of elongated nodes, such as have not, we believe, been heretofore found on any specimen.

The great number of plates, in the rim, and the elongated nodes on the margin will distinguish this species from all that have been heretofore described.

Found in the Hudson River Group on Orchard Creek, Alexander county, Illinois, and now in the collection of Wm. F. E. Gurley.

Through an oversight, proper credit was not given in Bulletin No. 5 to Prof. A. G. Wetherby, who discovered all the forms therein described from the Trenton Group of Mercer county, Ky., and Knox county, Tenn.; also, those from the Kaskaskia Group, of Pulaski county, Ky., as well as those from the Keokuk Group of Tennessee, in all some fifteen species, including one new family and three new genera. And the opportunity is here taken not only to make this correction, but to express to Prof. Wetherby our sincere thanks for the valuable assistance he has rendered in securing interesting specimens, as well as valuable information.

PLATE I.

Page.

BATOCRINUS SPINOSUS, n. sp. 5
- Fig. 1. Azygous side.
- Fig. 2. View opposite azygous side.
- Fig. 3. Basal view.

BATOCRINUS CURIOSUS, n. sp. 6
- Fig. 4. Azygous side.
- Fig. 5. View opposite azygous side.
- Fig. 6. Basal view.

BATOCRINUS CASULA, n. sp. 8
- Fig. 7. Azygous side.
- Fig. 8. Lateral view.

BATOCRINUS HONORABILIS, n. sp. 10
- Fig. 9. Azygous side.
- Fig. 10. View opposite azygous side.

BATOCRINUS WETHERBYI, n. sp. 11
- Fig. 11. Azygous side.
- Fig. 12. View opposite azygous side.

BATOCRINUS LATERNA, n. sp. 12
- Fig. 13. Lateral view, azygous area to the right.
- Fig. 14. Basal view, showing large diameter of the basal plates.

BATOCRINUS LACINIOSUS, n. sp. 14
- Fig. 15. Lateral view.
- Fig. 16. Azygous view.

BATOCRINUS CASUALIS, n. sp. 15
- Fig. 17. Lateral view.
- Fig. 18. Azygous view.

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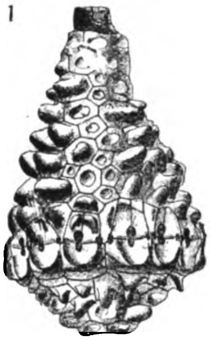

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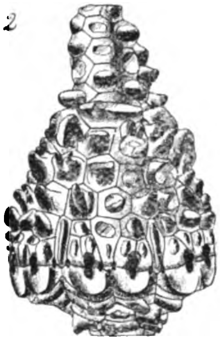

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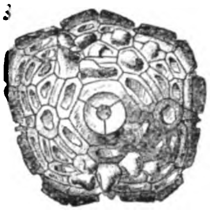

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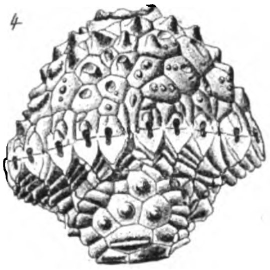

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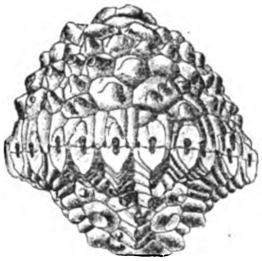

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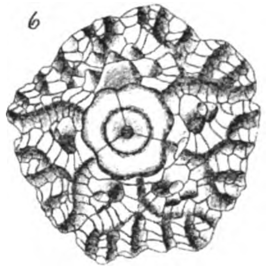

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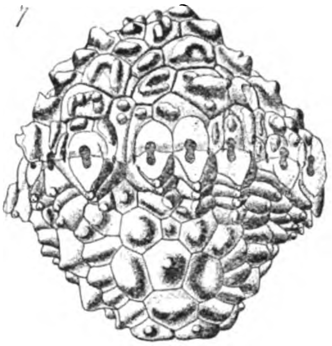

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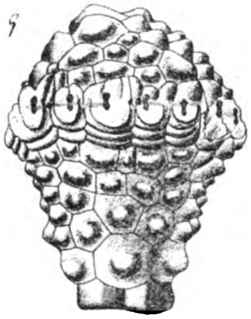

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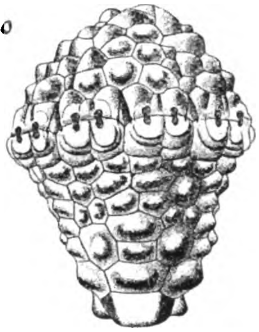

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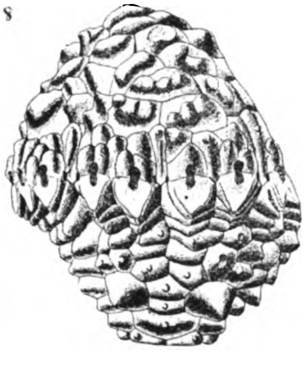

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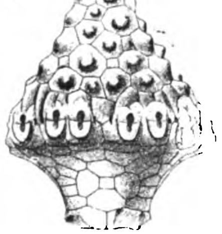

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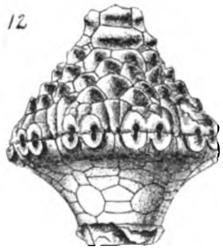

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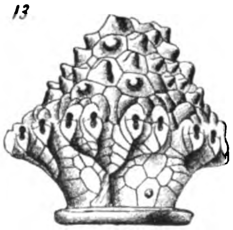

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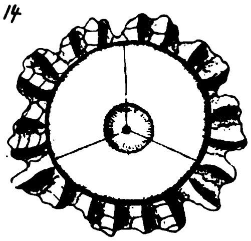

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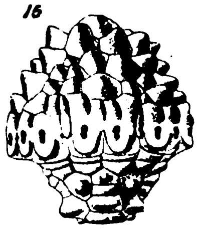

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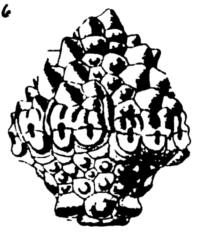

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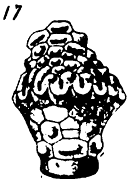

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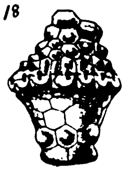

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PLATE II.

Page.

ACTINOCRINUS BOTRUOSUS, n. sp.............................. 22

Fig. 1. Azygous side.
Fig. 2. View opposite azygous side.

BATOCRINUS ARCULA, n. sp.............................. 16

Fig. 3. Azgous side.
Fig. 4. Summit view.
Fig. 5. Basal view.

BATOCRINUS PILEUS, n. sp.............................. 18

Fig. 6. Basal view.
Fig. 7. Summit view.
Fig. 8. Lateral view.

BATOCRINUS BURKETI, n. sp.............................. 19

Fig. 9. View of a specimen showing column, arms and azygous side of calyx.

BATOCRINUS LABELLUM, n. sp.............................. 21

Fig. 10. Azygous side.
Fig. 11. Basal view.
Fig. 12. Summit view.

SACCOCRINUS UMBROSUS, n. sp.............................. 24

Fig. 13. Lateral view, azygous area to the right.
Fig. 14. Lateral view, azygous area to the left.

ERETMOCRINUS COMMENDABILIS, n. sp.............................. 25

Fig. 15. View of a specimen showing column, arms and calyx.

PLATYCRINUS VASCELLUM, n. sp.............................. 32

Fig. 16. Basal view.
Fig. 17. Lateral view.
Fig. 18. Summit view.

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Bulletin No. 6. **Plate II.**

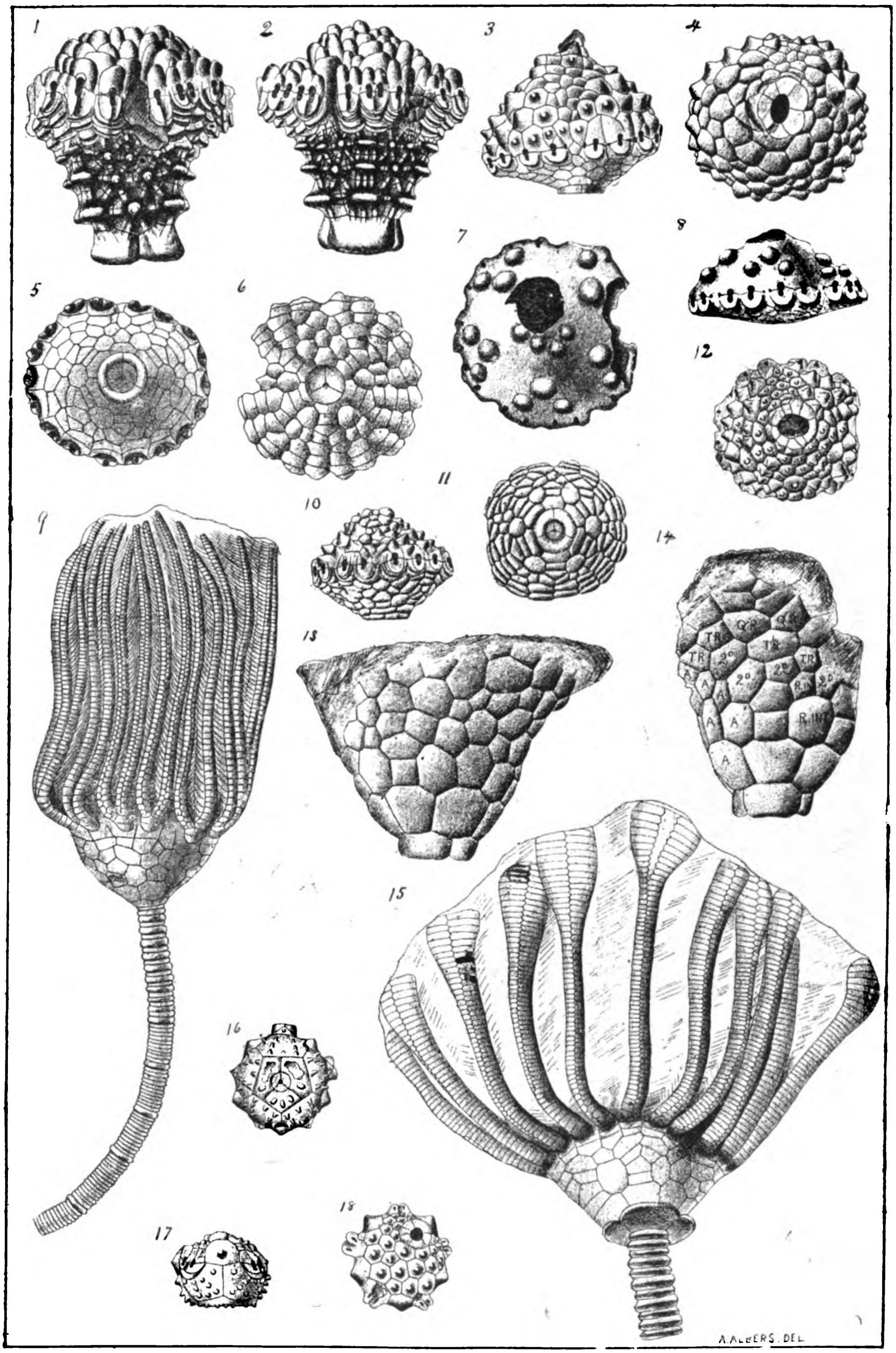

PLATE III.

Page.

AGARICOCRINUS PROFUNDUS, n. sp 26

Fig. 1. Basal view.
Fig. 2. Summit view.
Fig. 3. Azygous side view of a smaller specimen.

AGARICOCRINUS TURGUIUM, n. sp 28

Fig. 4. Basal view.
Fig. 5. Summit view.
Fig. 6. Azygous side view.

AGARICOCRINUS ARCULA, n sp 30

Fig. 7. Basal view.
Fig. 8. Summit view of a smaller specimen.
Fig. 9. Azygous side view of same.

ARCHÆOCRINUS KNOXENSIS, n. sp 34

Fig. 10. Basal view.
Fig. 11. Azygous side view.
Fig. 12. Summit view.

GILBERTSOCRINUS GREENEI, n sp. 35

Fig. 13. Basal view.
Fig. 14. Lateral view.
Fig. 15. Summit view.

GILBERTSOCRINUS INDIANENSIS, n. sp 36

Fig. 16. Basal view of a specimen showing some complete spines.
Fig. 17. Basal view of another specimen.
Figs. 18 and 19. Lateral views of the same.
Fig. 20. Basal view of a smaller specimen, probably of the same species.
Fig. 21. Summit view of the same.
Fig. 22. Lateral view of the same.

MACROSTYLOCRINUS INDIANENSIS, n. sp 33

Fig. 23. Side view of calyx.

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Bulletin No. 6. Plate III.

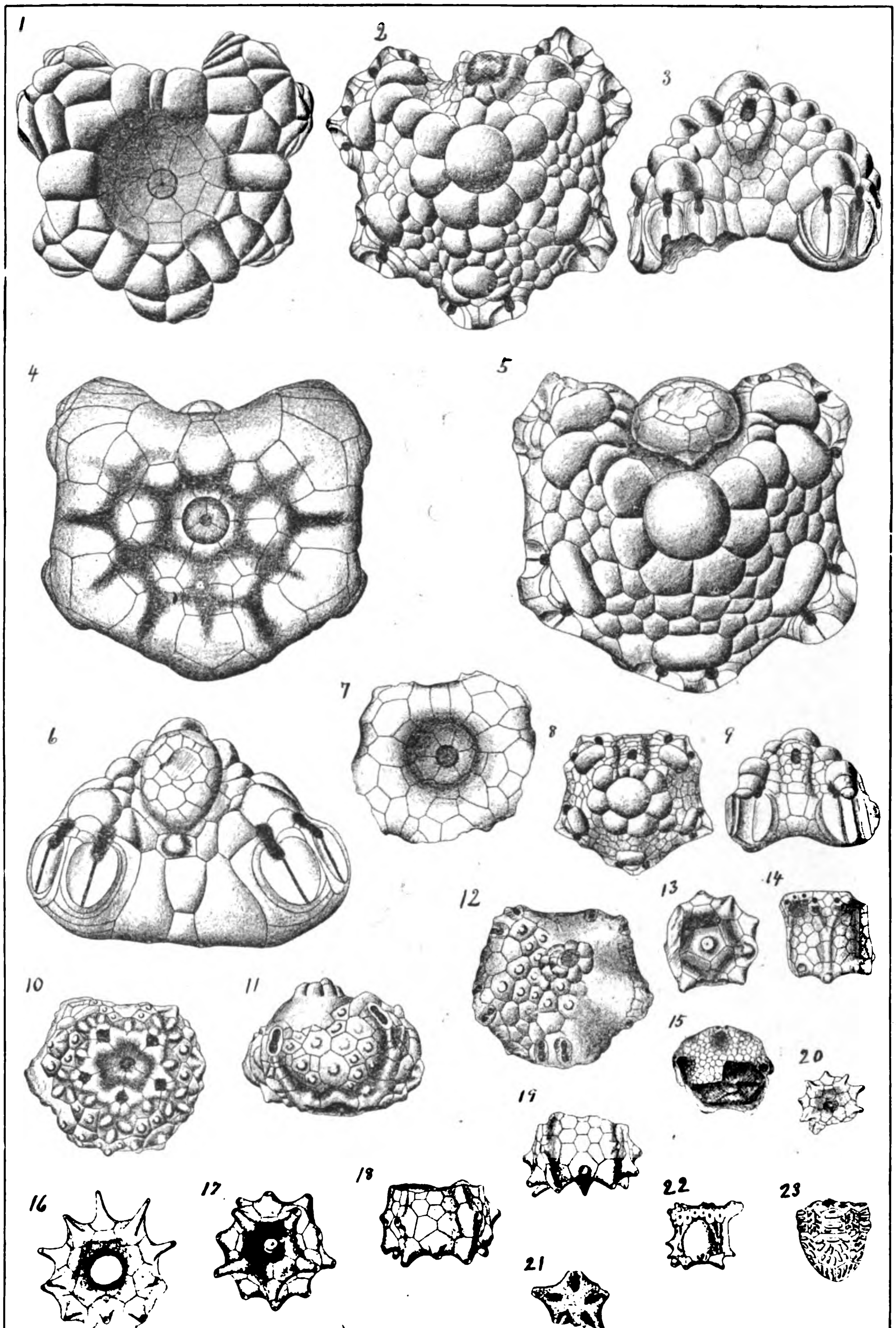

PLATE IV.

Page.

ONYCHOCRINUS PULASKIENSIS, n. sp. 40
Fig. 1. View showing column and part of arms.
Fig. 2. Azygous side of the same.

TAXOCRINUS WETHERBYI, n. sp. 41
Fig. 3. Basal view, azygous side down.
Fig. 4. Lateral view.
Fig. 5. Summit view.

PTEROTOCRINUS WETHERBYI, n. sp. 44
Fig. 6. Azygous side view.
Fig. 7. Basal view, azygous side down.
Fig. 8. Summit view.
Fig. 9. View of another specimen, showing furrowed vault.

POTERIOCRINUS VAGULUS, n. sp. 46
Fig. 10. Lateral view, azygous area to the left.
Fig. 11. Opposite side of the same.

ZEACRINUS PULASKIENSIS, n. sp. 47
Fig. 12. Azygous side view.
Fig. 13, Opposite side of same.

ZEACRINUS DURABILIS, n. sp. 48
Fig. 14. Azygous side view.
Fig. 15. Opposite side of same.

EMPEROCRINUS INDIANENSIS, n. sp. 43
Fig. 16. Basal view.
Fig. 17. Azygous side view.

BARYCRINUS WASHINGTONENSIS, n. sp 49
Fig. 18. Azygous side view.
Fig. 19. Opposite side of same.

CYLICOCRINUS INDIANENSIS, n. sp. 31
Fig 20. Basal view.
Fig, 21. Azygous side view.
Fig. 22. Lateral view.

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Bulletin No. 6. **Plate IV.**

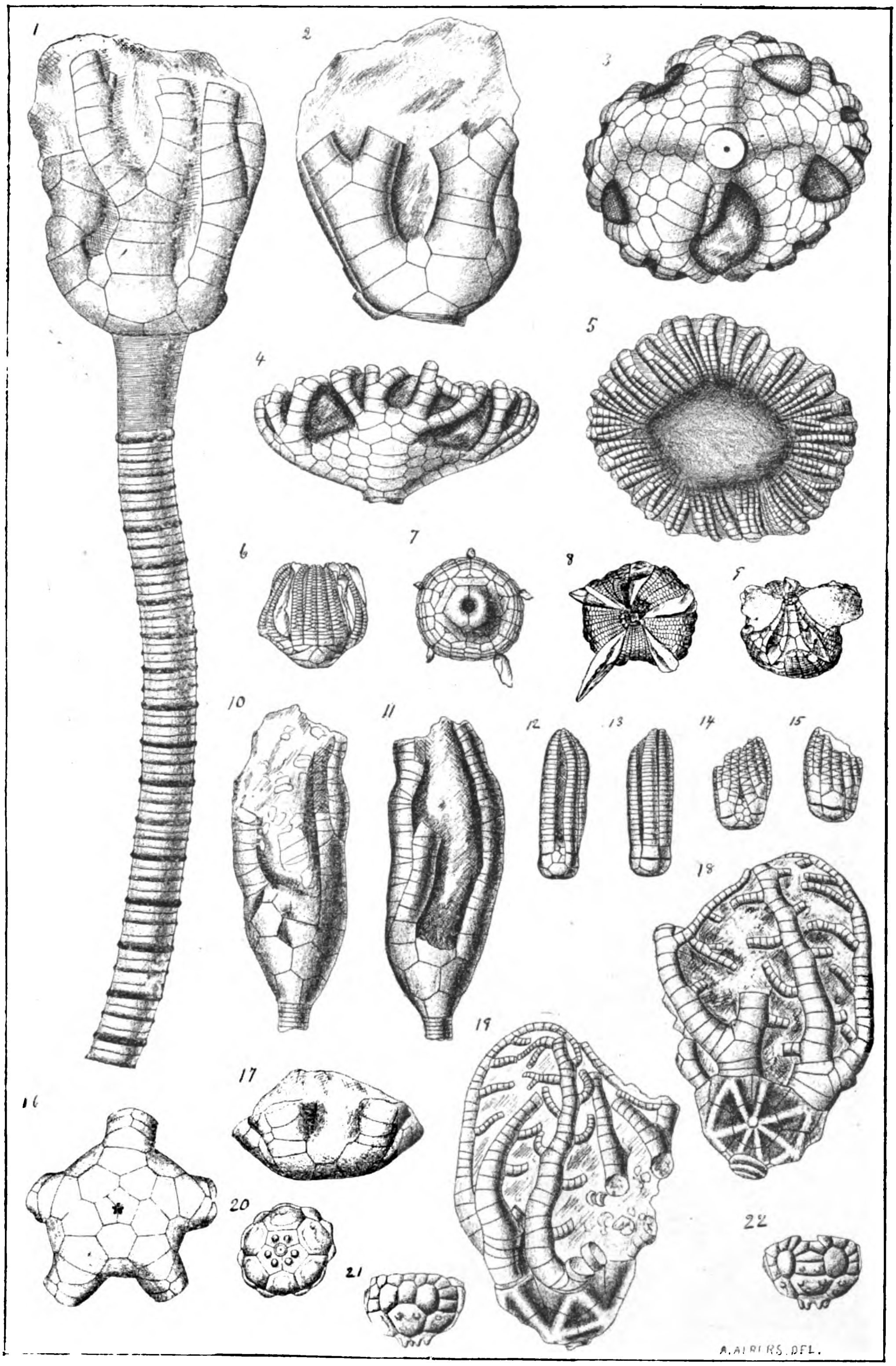

PLATE V.

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Dolatocrinus corporosus, n. sp. 50
Fig. 1. Basal view.
Fig. 2. Summit view.
Fig. 3. Azygous side view.

Dolatocrinus hammelli, n. sp. 52
Fig. 4. Basal view.
Fig. 5. Lateral view.
Fig. 6. Summit view.

Dolatocrinus vasculum, n. sp. 53
Fig. 7. Basal view.
Fig. 8. Summit view.
Fig. 9. Azygous side view.

Dolatocrinus exornatus, n. sp. 54
Fig. 10. Basal view.
Fig. 11. Lateral view, azygous area to the left.
Fig. 12. Summit view.

Dolatocrinus pulchellus, n. sp. 55
Fig. 13. Basal view.
Fig. 14. Lateral view.
Fig. 15. Summit view.

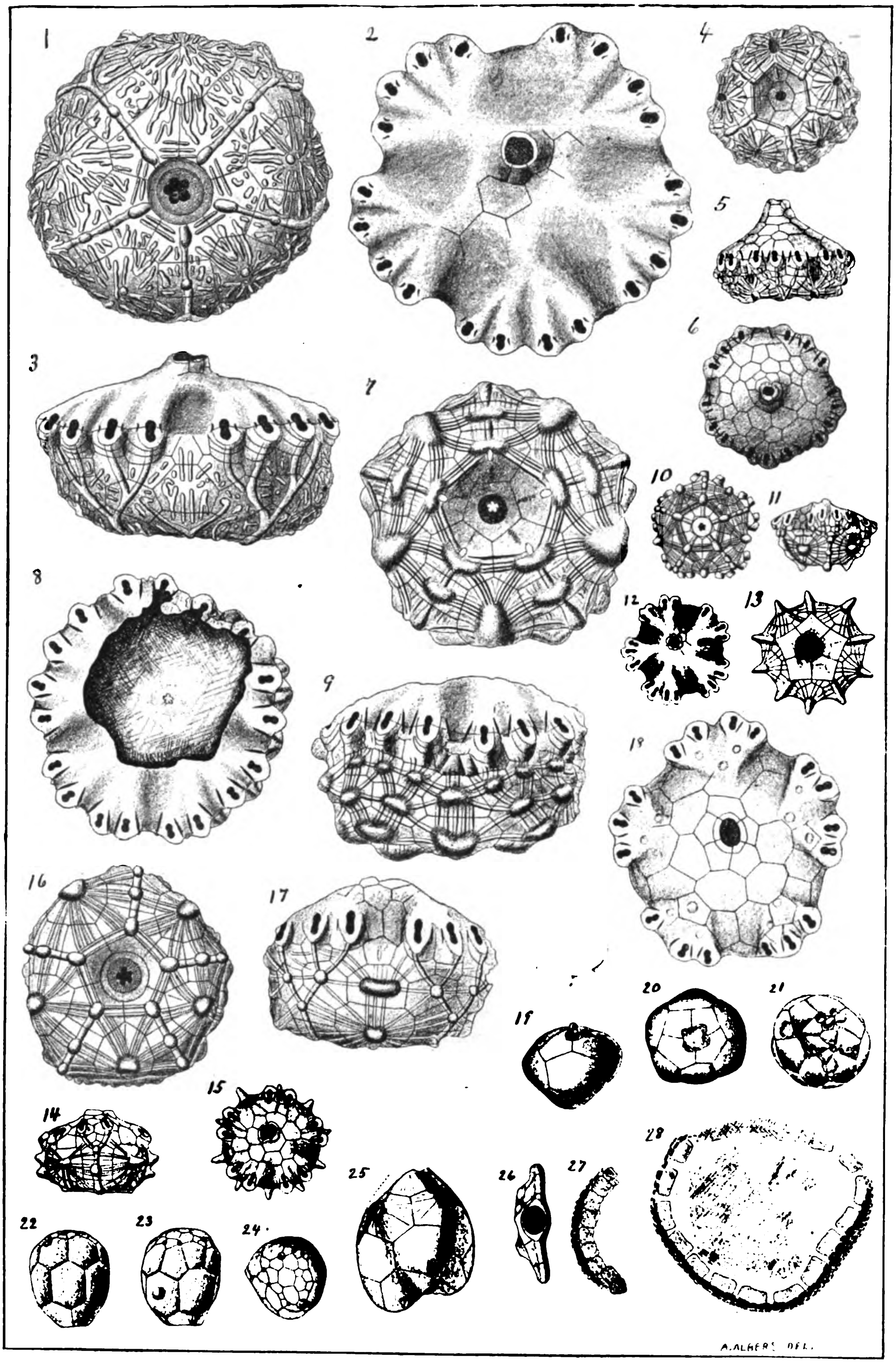
Dolatocrinus bellulus, n. sp. 57
Fig. 16. Basal view.
Fig. 17. Azygous side view.
Fig. 18. Summit view.

Stribalocystites sphaeroidalis, n. sp. 58
Fig. 19. Anterior view.
Fig. 20. Basal view.
Fig. 21. Summit view.

Caryocrinus kentuckiensis, n. sp. 59
Fig. 22. Anterior view.
Fig. 23. Posterior—lateral view.
Fig. 24. Summit view.

Pleurocystites mercerensis, n. sp. 60
Fig. 25. Dorsal view.
Fig. 26. Basal view.

Cyclocystoides illinoisensis, n. sp. 61
Fig. 27. Outer rim of a specimen.
Fig. 28. Fragment of outer rim of another specimen.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BULLETIN NO. 7

OF THE

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OF

NATURAL HISTORY

NEW AND INTERESTING SPECIES OF PALÆOZOIC FOSSILS.

5 plates

By S. A. MILLER and WM. F. E GURLEY.

SPRINGFIELD, ILLINOIS,
DECEMBER 5, 1895.

SPRINGFIELD, ILL.,
ED. F. HARTMAN, STATE PRINTER.
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NEW AND INTERESTING SPECIES OF PALÆOZOIC FOSSILS.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA.

FAMILY ACTINOCRINIDÆ.

BATOCRINUS POLYDACTYLUS, n. sp.

Plate I, Fig. 1, view of calyx, arms and part of the column, azygous area on the right.

Species above medium size. Clayx short, saucer-shaped, about four times as wide as high; interradial areas slightly flattened; surface granular. Column medium size and composed of alternately larger and smaller plates.

Basals form an hexagonal disc, less than twice the diameter of the column, bearing a low rim around the depression for the attachment of the column. First primary radials more than twice as wide as high. Second primary radials quadrangular, nearly three times as wide as high. Third primary radials not much larger than the second, twice as wide as high, pentagonal, axillary, and support upon the upper sloping sides the secondary radials. In each lateral ray and in the ray opposite the azygous area there are two secondary radials, the last of which are axillary and bear three tertiary radials, the last one being axillary and bearing two arms; which gives to each of these rays eight arms. The ray on the right of the azygous area bears three secondary radials, the last one being axillary and bearing two arms, which gives to this ray four arms. The ray on the left of the azygous area bears, on the distal side, three secondary radials. the last of which is axillary, and on the proximal side two secondary radials, the last of which is axillary, and bears on the distal side two tertiary radials, and on the proximal side three tertiary radials, the last one being axillary, giving to this ray five arms. There are, therefore, thirty-three arms in this species. The arms are composed of a double series of interlocking plates that are deeper than wide in the lower part, but commence to spread, at the upper third, and become perfectly flat, in the upper part, as they do in *Eretmocrinus*, but without the usual increase in width. The plates of the arms do not seem to lengthen, but instead of closing, so as to have an ambulacral furrow on the inner side, they become perfectly flat on both sides, or concave externally. Pinnules dense.

There are three regular interradials in each area, one large, the other two small, but of unequal length. There are seven azygous interradials, the first one heptagonal, in line with the first primary radials, and of about the same size. It is followed by three plates, in the second range, the middle one being the longer and larger one. On each side of the upper part of the middle plate there is a small plate that separates it from the radial series. Above the middle plate of the second range, there is an elongated plate that extends an angle to the top of the calyx. The vault is not exposed, but it bears a long slender proboscis, the end of which is broken off at the top of the specimen illustrated.

This specie will be distinguished by its depressed calyx, and thirty-three arms or seventeen ambulacral orifices, in the vault, and by the flattening of the arms in the superior part. This latter character, in a greater degree, possibly, has been regarded as a generic character in *Eretmocrinus*. This species and others hereinafter described show that the flattening of the arms is not of generic importance. Many species of *Batocrinus* show the tendency of the arms to expand or flatten toward the superior ends.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A Miller.

BATOCRINUS SAMPSONI, n. sp.

Plate I, Fig. 2, azygous view of a specimen compressed so as to show calyx and arms; Fig. 3, lateral view of another specimen having part of the arms removed, showing vault, proboscis and the incurving part of the arms, some of which are broken off.

Species medium size. Calyx obconoidal, twice as wide as high; each radial series where unworn bears a slight angular ridge from the basal plates to the free arms; interradial areas flattened but very little; surface granular; truncated for a small column.

Basals form an hexagonal disc, one-half wider than the diameter of the column, and having a height less than the distance from the column to the margin. First primary radials wider than high, upper face slightly arcuate for the reception of the second radials. Second primary radials quadrangular, about twice as wide as high. Third primary radials pentagonal, a little larger than the second, not quite twice as wide as high, axillary, and support upon the upper sloping sides the secondary radials The distal side of each third primary radial, adjoining the azygous area, bears four secondary radials, the last of which is axillary, and supports upon each upper sloping side a free arm; the proximal side of each bears two secondary radials, the last of which is axillary and supports upon the distal side two tertiary radials, the last one being axillary and supporting upon each upper sloping side a free arm; the proximal side of each secondary radial bears three tertiary radials that support a single arm. This arrrngement gives to each of these rays five arms. In each lateral ray there are two secondary radials, the last one being axillary and supporting the tertiary radials. In one of these each distal series supports four tertiary radials, the last one being axillary and supporting upon each upper sloping side a free arm, and each proximal series supports three tertiary radials, the last of which supports a free arm which gives to this lateral ray six arms. In the other lateral ray, one of the distal series supports three tertiary radials, the last one being axillary and supporting upon each upper sloping side a free arm; the other distal series and each proximal series, support three tertiary radials each of which supports a free arm, which gives to this lateral ray five arms. In the ray opposite the azygous area there are four secondary radials, the last of which is axillary and supports upon each upper sloping side a free arm, which gives to this ray four arms. There are, therefore, twenty-five arms, in this species. The arms are composed of a double series of interlocking plates that are deeper than wide, in the lower part, but flatten out above as they do in *Eretmocrinus*, but without the usual increase in width. Pinnules long and dense.

There are three regular interradials in each area, one large, the other two smaller and somewhat elongated. There are six azygous interradials, the first one heptagonal, in line with the first primary radials, and the largest plate in the calyx. It is followed by three plates, the central one being smaller than the lateral ones; and these by two elongated plates that connect with the plates of the vault. The vault is conoidal and larger than the calyx, and bears a long subcentral proboscis. The plates of the vault and proboscis are large and smooth.

This species will be distinguished by its general form, and twenty-five arms that are flattened toward their terminal ends. This latter character belongs to all species that have been referred to *Eretmocrinus*. This species and others herein described show that the flattening of the arms is not of generic importance, though, in a marked degree, it is no doubt of specific value. We have, heretofore, shown that the other characters ascribed to *Eretmocrinus* are possessed by different species of *Batocrinus* and that one and all are not of generic value.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of F. A. Sampson, the well known naturalist of Sedalia, Missouri.

BATOCRINUS VETERATOR n. sp.

Plate I, Fig. 4, view of calyx and arms opposite the azygous side, a little depressed, and arms broken off at the upper end.

Species medium size. Calyx obconoidal, two and a half times as wide as high; no radial ridges; plates slightly convex; sutures distinct, somewhat beveled; surface granular; column small.

Basals form an hexagonal disc twice as wide as the diameter of the column and having a height less than half the distance from the column to the margin. First primary radials one-half wider than high, and superior face nearly straight. Second primary radials quadrangular, about three times as wide as long. Third primary radials pentagonal, a little larger than the second, about three times as wide as long, axillary, and support on the upper sloping sides the secondary radials. In the ray opposite the azygous area there are three secondary radials on one side and an axillary plate that bears two arms; on the other, there are two secondary radials, the last of which is axillary and bears, upon one side, a tertiary plate, which supports a single arm, and upon the other a tertiary plate, which is followed by an axillary plate that bears two arms. There are, therefore, five arms in this ray. One of the lateral rays is constructed in the same manner and bears five arms. In the other lateral ray there are two secondary radials in each series, the last of which are axillary and bear, upon one side, two tertiary radials that support a single arm on each, and upon the other side two tertiary raidials, the last being axillary and supporting two arms. There are, therefore, six arms in this ray. The ray on the right of the azygous area also supports six arms, while the ray on the left of the azygous area supports seven arms, the proximal one being a single arm and the other three double arms. By this arrangement there are twenty-nine arms in this species. The arms are long and very slightly flattened toward the superior ends. Pinnules very dense.

In the regular interradial areas there are only two plates, one following the other. In the azygous interradial area the first plate is heptagonal, in line with the first primary radials and of about the same size. It is followed by three plates in the second range, which nearly fill the area, above these the sutures are indistinct in each of our specimens, but, apparently, there is only one plate. making five plates in this area. The vault is not disclosed in our specimens, but two of them show the broken ends of the proboscis, which is quite small.

The arms, in the specimen illustrated, are broken off and eroded toward the top, which causes the arms to appear to flatten more than they really do. Another specimen showing nearly the entire length of the arms, shows only a little flattening at the tips—about the same shown in *B. venustulus*.

This species is distinguished by its general form, number of interradials, and the peculiarity in the arrangement of its twenty-nine arms.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS VETUSTUS, n. sp.

Plate I, Fig. 5, azygous side view of the calyx and part of the arms; Fig. 6, opposite view of the same specimen.

Species medium size. Calyx obpyramidal, twice as wide as high; each radial series bears an angular ridge from the basal plates to the free arms; interradial areas flattened; sutures slightly beveled; surface granular; truncated for a small column.

Basals form an hexagonal disc one-half wider than the diameter of the column and having a height less than half the diameter of the column. First primary radials wider than high, upper face slightly arcuate for the reception of the second radials. Second primary radials quadrangular, about twice as wide as high. Third primary radials pentagonal, except in the typical specimen, the one on the right of the azygous area is hexagonal, and the one opposite the azygous area is heptagonal, as shown in figure 5. Moreover, in the typical example, there are four primary radials, in one of the lateral series, as shown on the left of figure 6. The extra plate is pentagonal and inserted between the second and third primary radials. The third primary radials are of unequal size, axillary, and bear upon each upper sloping side secondary radials. On the right side of the azygous area, on the distal side, there are three secondary radials and an axillary plate that bears two arms, and on the proximal side two secondary radials, the last being axillary and bearing upon each upper side two tertiary radials, each of which bears a single arm, which gives to this ray four arms. On the left side of the azygous area, on the distal side, there are four secondary radials that bear a single arm, and on the proximal side two secondary radials, the last of which is axillary, and bears upon the distal side two tertiary radials that bear a single arm, and on the proximal side three tertiary radials, the last being axillary and supporting two arms, which gives to this ray four arms. It will be noticed that the number of arms in each of these rays is the same, but the arrangement is reversed. In one lateral ray there are upon each side of the third primary radial four secondary radials, the last being axillary and supporting two arms, which gives to this ray four arms. In the other lateral ray there are upon each side of the third primary radial two secondary radials, the last being axillary and bearing upon each upper sloping side three tertiary radials, the last of which is axillary in three rays and supports two arms, and the other one supports a single arm, which gives to this ray seven arms. In the ray opposite the azygous area there are upon one side five secondary radials that bear a single arm, and upon the other side five secondary radials, the last being axillary and supporting two arms, which gives to this ray three arms. There are, therefore, twenty-two arms in this species. The arms are composed of a double series of interlocking plates that are deeper than wide, and, as far as preserved in the typical specimens, show no tendency to flatten toward the superior ends. Pinnules long and dense.

In part of the regular interradial areas there are five plates, one followed by two, and then one in the third, and one in the fourth range—in other areas there are six plates—two in both the second and third ranges. In the azygous area there are thirteen plates. The first one is heptagonal, in line with the first primary radials and fully as large as any of them. It is followed by three plates in the second range, five in the third range, three in the fourth range and one in the fifth range that unites with the plates of the vault. Our specimens do not disclose the vault and proboscis.

This species is distinguished by the numerous interradials and azygous plates, and by the order and arrangement of twenty-two arms. The fourth primary radial in one of the rays is abnormal, or the commencement of development toward some other form, that is unknown, provided other specimens, in this species, do not retain the same character, in which case, it might be a specific character. We have the character preserved, only in the specimen that is illustrated.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS VENUSTULUS, n. sp.

Plate I, Fig. 7, azygous side of calyx and arms, a little depressed.

Species medium size. Calyx obconoidal, twice as wide as high; each radial series bears a low angular ridge from the basal plates to the free arms; interradial areas slightly flattened; surface granular; truncated for a medium-sized column.

Basals form an hexagonal disc one-third wider than the diameter of the column and having a height less than the distance from the column to the margin. First primary radials very little wider than high, upper face slightly arcuate for the reception of the second radials. Second primary radials quadrangular, more than twice as wide as high. Third primary radials pentagonal, a little larger than the second, about twice as wide as high, axillary, and support upon the upper sloping sides the secondary radials. On the distal side of the third primary radial, on the right of the azygous area there are four secondary radials, the last of which is axillary and supports upon each upper sloping side a free arm; on the proximal side there are two secondary radials, the last being axillary and supporting upon the distal side two tertiary radials and upon the proximal side three, the last ones supporting free arms, which gives to this ray four arms. In the ray on the left of the azygous area, the third primary radial supports, upon each upper sloping side, two secondary radials, the last being axiliary and the proximal series bears on the proximal side two tertiary radials and on the distal side two tertiary radials and an axillary plate that supports two arms; the distal series bears upon each upper sloping side two tertiary radials one of which bears an axillary plate that supports two arms. This arrangement gives to this ray six arms.

In each lateral ray the third primary radial supports upon each upper sloping side two secondary radials the last being axillary and bearing upon each upper sloping side three tertiary radials and an axillary plate which supports two arms, which gives to each of these rays eight arms. In the ray opposite the azygous area, there are three secondary radials followed by an axillary plate that supports two arms, in one series, and, in the other, there are three arms, which gives to this ray five arms. There are, therefore, in this species, thirty-two arms. The arms are composed of a double series of interlocking plates that show a slight tendency to flatten at the incurving superior ends, but not to be compared in this respect with *Batocrinus Sampsoni*. Pinnules long and dense.

In one of the interradial areas there are three plates, one followed by two smaller ones; in two of the areas there are four plates in each, one followed by two in the second range and one in the third; and in the other area there are five plates, one followed by two in the second range and two in the third. There are seven azygous interradials, the first one heptagonal, in line with the first primary radials and of about the same size. It is followed by three plates, the central one being larger than the lateral ones; and these by two plates, in the third range, and one in the fourth, that is somewhat elongated and reaches the plates of the vault. Vault conoidal, and sub central proboscis smaller than in *B. Sampsoni*.

This species will be distinguished by the arrangement of its thirty-two arms from all other species. The same tendency of the arms to flatten near the upper ends has been discovered in other species of *Batocrinus* that has been overlooked by authors. But where the flattening is as slight as in our specimens of this species, it is probable that other specimens will not show any flattening, and that the character is not even of specific importance, and, moreover, it is probable that it does not exist in younger specimens, which would again tend to destroy its importance.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS INSUETUS, n. sp.

Plate I, Fig. 8, azygous view of calyx, vault, proboscis and part of the arms; Fig. 9, side view of same specimen.

Species rather below medium size. Calyx obconoidal, truncated below, about twice as wide as high; surface smooth or finely granular. Column medium size.

Basals form an hexagonal disc one half wider than the diameter of the column, with a central depression and rim around it, for the attachment of the column. First primary radials wider than high. Second primary radials quadrangular, short, two or more times as wide as high. Third primary radials a little larger than the second, twice as wide as high, pentagonal, axillary, and support on the upper sloping sides the secondary radials. In each lateral ray, the third primary radial supports, upon each upper sloping side, two secondary radials, the last of which is axillary and supports upon each upper sloping side a tertiary radial, that bears a single arm. There are, therefore, four arms in each of these rays. The distal side of each third primary radial adjoining the azygous area supports three secondary radials that bear a single arm; the proximal side of each supports two secondary radials, the last of which is axillary and supports upon each side a tertiary radial that bears a single arm. There are, therefore, three arms to each of these rays. In the ray opposite the azygous area, the third primary supports upon each upper sloping side three secondary radials, the last of which supports a single arm. There are, therefore, sixteen simple arms in this species and sixteen ambulacral openings to the vault. The arms are rather small and composed of a double series of interlocking plates that are slightly deeper than wide, in the lower part, but the arms flatten out near the superior ends, as they do in many other species in this genus. Pinnules long and dense.

There are three regular interradials in each area, one large, the other two small. There are four azygous interradials, one heptagonal, in line with the first primary radials and slightly larger and longer than either of them. It is followed by three plates, the middle one being the larger and longer, but it is cut off from the vault by the tertiary radials. The vault is highly convex, with a large proboscis that terminates in a balloon-shaped bulb, that has the azygous opening at one side of the summit. The plates of the vault are plain, or slightly convex, and smooth, but each plate, on the central and lower part of the balloon, bears a central tubercle, while the small plates on top and surrounding the orifice are smooth.

This species will be distinguished by the arrangement of its sixteen arms, by the four plates in the azygous area, and by the balloon-shaped proboscis. The shape of the vault and proboscis, in this genus, varies so much, that it may be doubtful about how far its form may be regarded as of even specific importance. We have among the species herein described the long slender proboscis extending beyond the arms, the balloon-shaped proboscis, with arms capable of spreading all over it, and the convex vault, without proboscis, save a swelling area like a recumbent proboscis, with the azygous orifice below the ambulacral canals. The breaking up of the genus *Batocrinus*, on characters, based on the vault, azygous orifice, and superior part of the arms, into subgenera or distinct generic names does not seem to be practicable or natural.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS BROADHEADI, n. sp.

Plate I, Fig. 10, basal view azygous side up; Fig. 11, view opposite the azygous area.

Species full medium size and among the larger forms with which it is associated. Calyx somewhat hemispherical, in general outline, rather more than twice as wide as high; radial series forming low, angular ridges from the basal plates to the free arms; interradial areas gently rounded; arm openings directed nearly horizontally; sutures distinct; surface granular.

Basals form an hexagonal disc that expands a little beyond the angles of the radial ridges, and has a diameter two and a half times the diameter of the column, and a hemispherical depression in the truncated surface below, for the attachment of the column. First primary radials twice as wide as long, longitudinally angular in the central part. Second primary radials quadrangular, and varying from one and a half to two and a half times as wide as long. Third primary radials pentagonal, larger than the second, wider than high, greatest width below the middle, at the angles formed by the junction of the lower expanding and upper sloping sides, axillary, and supporting on each upper sloping side the secondary radials. In the ray on the right of the azygous area, and in each lateral ray, there are two secondary radials, the second one of which is axillary, and bears upon each superior side two tertiary radials, which gives four arms to each of these three rays. In the ray on the left of the azygous area, there are two secondary radials, in the proximal series, the second one of which is axillary, and bears upon the proximal side two tertiary radials, and on the distal side one large tertiary radial, and in the distal series there are two secondary radials only, the last one being quite large. This gives to this ray three arms. In the ray opposite the azygous area the third primary radial bears upon each superior sloping side three secondary radials, which gives to this ray two arms. There are, therefore, seventeen arm openings to the vault in this species.

In the regular interradial area, between the three and four armed rays, there are only three plates, one very large followed by two elongated plates, one of which extends higher than the other. In each of the other three regular interradial areas there are four plates, one large plate, followed by two in the second range and one in the third. The azygous area is subovate in outline and contains nine plates. The first one is in line with the first radials, but smaller and narrower; it is followed by three much larger plates in the second range, and these by three in the third range, which are supported on two of the plates of the second range. Above the middle one in the third range there is a small plate, and between its right superior sloping side and the left superior side of the upper plate, in the third range, an elongated plate is supported that extends its superior angle between the second tertiary radials and unites with the plates of the vault.

Vault conoidal, slightly depressed in the interradial areas, and covered with rather large, polygonal, convex plates. Two small ovarian (?) apertures may be distinguished between the ambulacral openings in the azygous area; they are above the tertiary radials, at the angles between the two vault plates, in the azygous depression, and the smaller plate at each side of the ambulacral canals. Proboscis unknown.

Found in the Keokuk Group at Boonville, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of Prof. G. C. Broadhead, formerly State Geologist of Missouri, a gentleman of high scientific attainments, whose professional skill and untiring energy has to such a great extent contributed to our knowledge of the geology, as well as to the wonderful development of the mining and economical industries of that state.

BATOCRINUS NITIDULUS, n. sp.

Plate I, Fig. 12, azygous view of calyx and vault; Fig. 13, opposite view of same.

We have four specimens of this species of the same size and in the same state of preservation as the one illustrated. None of them show any of the arms.

Species below medium size. Calyx broadly truncated below and obconoidal above, or like the frustum of a cone; one-half wider than high. Plates convex, usually bearing a transverse angular ridge, and beveled from the central part to the sutures. No radial ridges. Column small and having a very small, round, columnar canal.

Basals form an hexagonal disc nearly twice as wide as the diameter of the column and having a height less than half the diameter of the column. First primary radials wider than high. Second primary radials quadrangular, about three times as wide as high. Third primary radials vary from pentagonal to heptagonal depending upon the number of interradials that each side abuts against, and they vary somewhat in size, but are about twice as large as the second radials, axillary, and support on each upper sloping side two secondary radials, the last one of which is axillary and supports on each upper sloping side a single tertiary radial. There are, therefore, four arm openings to the vault from each ray or twenty ambulacral openings to the vault. The probability is that the arms did not bifurcate and that the species had only twenty arms.

There are three regular interradials, in each area, one large the other two smaller and somewhat elongated, in the specimen illustrated; but in other specimens in some of the areas, there are only two plates, one following the other. There are eight azygous interradials in the specimen illustrated, the first one heptagonal, in line with the first primary radials and of about the same size. It is followed by three plates, the middle one being the smaller, and these are followed by four smaller plates that are cut off from the vault by the union of the tertiary radials. In some of the other specimens, there are only three plates in the third range and, hence, only seven azygous plates. The vault is conoidal, covered with convex plates and bears an almost central proboscis.

This species is distinguished by its trim, neat form, beveled plates and twenty ambulacral openings to the vault. This is one of the forms that might be referred to ***Eretmocrinus***, if that were a valid genus.

Found in the Keokuk Group, at Boonville, Mo., and now in the collection of S. A. Miller.

BATOCRINUS PECULIARIS, n. sp.

Plate I, Fig. 14, azygous side view; Fig. 15, basal view; Fig. 16, summit view of the same specimen.

Species below medium size. Calyx somewhat obconoidal, but spreading upward canopy-like, and directing the ambulacral openings horizontally. Truncated nearly three times the diameter of the column; plates moderately convex; sutures plain; surface granular. Column small; canal cinque foil.

Basals form an hexagonal disc nearly three times the diameter of the column, concave centrally below for the attachment of the column, and having a height equal to about half the diameter of the column. First primary radials wider than high. Second primary radials quadrangular, three times as wide as high. Third primary radials pentagonal, larger than the second, nearly three times as wide as high, axillary and support on the upper sloping sides the secondary radials. On the distal side of each ray adjoining the azygous area there are three secondary radials, and on the proximal side two secondary radials, the last of which is axillary and bears upon each upper slopping side two tertiary radials, which gives to each of these rays three arms. One of the lateral rays is constructed in like manner and bears three arms. The other lateral ray bears upon each of the upper sides of the third primary radial two secondary radials, the last being axillary and supporting on each upper sloping side two tertiary radials, which gives to this ray four arms. In the ray opposite the azygous area there are three secondary radials, which gives to this ray two arms. There are, therefore, fifteen arms in this species, as shown by the ambulacral openings to the vault.

There are three regular interradials in each area, one large, the other two small and somewhat elongated. The azygous area is very peculiar, as the proboscis having the azygous orifice separates the tertiary radials and projects below the ambulacral openings and occupies nearly half the azygous area. The first plate is heptagonal, in line with the first primary radials and the largest plate in the body. There are three plates in the second range, the middle one being the smaller and supporting the plates that surround the azygous orifice. In the third range, on one side of the recumbent proboscis or azygous ridge, there is one rather large plate, and all the other plates in the area are small and form part of the round recumbent proboscis. The vault is highly convex, and has a capacity equal to or greater than that of the calyx. It is covered with small, convex, polygonal plates. Upon the azygous side of the center a convex elevation arises that becomes more defined as it passes down between the ambulacral orifices and finally projects, like the end of a proboscis, below the arms in the upper third of the azygous area. It appears like the recumbent proboscis in *Siphonocrinus armosus*, though not projecting quite as much. Probably the word "proboscis" should not be used in the definition, for it is merely a rounded ridge from one side of the vault that terminates in a hemispherical projection that bears an orifice in the upper part of the azygous area, as shown in the illustration.

This species is distinguished by its general form, convex vault, recumbent proboscis with orifice below the arms, and by its fifteen arms, from all other species. By some it might be referred to *Dorycrinus*, but we think it is clearly a *Batocrinus*. Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS IMPARILIS, n. sp.

Plate I, Fig. 17, azygous view; Fig. 18, opposite azygous side

We have several specimens of this species varying from half the size of the one illustrated to about one-fourth larger. None of them show any of the arms, and the one illustrated is best preserved.

Calyx urn-shaped; about one-fourth wider than high, though sometimes nearly as high as wide. Plates tumid; no radial ridges; sutures distinct; column small; surface granular.

Basals form a very low hexagonal cup about three times as wide as the diameter of the column. The columnar facet is round, deep and preserves the serrated lines for the attachment of the column. The convexity of the plates extends below the point of attachment of the column. The first primary radials are much larger than any other plates in the body and have a height nearly equaling the width. Second primary radials quadrangular, about twice as wide as high. Third primary radials very little larger than the second, pentagonal, axillary, and support on each upper sloping side of three rays two secondary radials, which gives to each of these rays two arms. Each third primary radial adjoining the azygous area bears upon the distal upper side two secondary radials, the last one bearing a single arm, and upon the proximal side two secondary radials the last of which is axillary and bears upon each upper sloping side a single tertiary radial which gives to each of these rays three arms. There are, therefore, twelve arm openings to the vault in this species.

There are three regular interradials in each area; one large, the other two smaller, somewhat elongated, and unite with the plates of the vault. The azygous area is large. The first plate is in line with the first primary radials and of about the same size. It is followed by three rather large plates, in the second range, and these, by three small plates, in the third range, that unite with three plates that separate the arms and unite with the plates of the vault. The vault is convex and covered with convex polygonal plates. The proboscis is small and subcentral, but it is broken off close to the vault in all our specimens.

This species is distinguished by its general form, convex plates, union of interradials with the plates of the vault, and by having twelve arms. It cannot be mistaken for any other described species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS INCULTUS, n. sp.

Plate I, Fig. 19; azygous view; Fig. 20, opposite azygous side.

We have four specimens which we refer to this species, though there is some difference in the azygous areas. None of them show any arms. Species below medium size. Calyx urn-shaped and nearly as high as wide. Plates highly convex; no radial ridges; sutures distinct. Column round, rather large and having a cinque foil canal.

Basals form an elevated hexagonal cup about twice as wide as the diameter of the column and having an hemispherical depression below, for the insertion of the column. The first primary radials are the largest plates in the body, except the first azygous plate, and have a height nearly equal to the width. Second primary radials, quadrangular, and about or less than one-half wider than high. Third primary radials considerably larger than the second, and pentagonal or hexagonal, depending on the number of plates they abut upon, in the interradial areas, axillary, and support on each of the superior lateral sides two secondary radials, each of which bears a single arm. There are, therefore, ten arm openings to the vault, in this species.

The regular interradial areas are elongated and generally have four plates, but sometimes only three. There is one in the first range, generally two elongated plates in the second range, but sometimes only one, and one elongated plate in the third range that connects with the plates of the vault. The azygous area is large, and the number of plates is not uniform. The first plate is in line with the first primary radials and fully as large as any of them. It is followed, in the specimen illustrated, in the second range, by four plates, but, in other specimens, there are only three. Above these, in the specimen illustrated, there are three plates, followed by two plates that connect with the plates of the vault, but in other specimens only three or four plates can be distinguished.

The vault is convex and is covered by a few large convex plates, and bears a large subcentral proboscis, which is surrounded, near the base, by large convex plates.

This species bears some resemblance to ***B. imparilis***, above described, but the calyx is more elongated, the vault and proboscis are altogether different, and it has only ten arms, while that species has twelve. When compared with other described species the differences are equally as well defined. We may here call attention to the fact, that the number of plates in the azygous and regular interradial areas, in the genus ***Batocrinus***, is of less importance than the number of ambulacral openings to the vault, not only as shown by this species, but as shown by many others, in our possession.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS INSPERATUS, n. sp.

Plate I, Fig. 21, azygous view; Fig. 22, opposite azygous side.

This species is founded upon a single specimen, that seems to be perfect in all its parts, and, if abnormal, we do not know from what parents it arose. The calyx and vault together have a sub-elliptical outline with both ends slightly truncated. Species below medium size. Calyx urn-shaped, about as high as wide. Plates tumid; no radial ridges; sutures distinct; surface granular. Column round and small. It has, however, only four radial series.

Basals form an elevated hexagonal cup, about twice as wide as the diameter of the column, and having, the plates rounded below to a hemispherical depression for the insertion of the column. First primary radials wider than high and of unequal size, though there are only four of them. Second primary radials quadrangular, and nearly as long as wide. Third primary radials considerably larger than the second, three hexagonal and one heptagonal, axillary, and support on each of the superior sloping sides two secondary radials, each of which bears a single arm. There are, therefore, eight arm openings to the vault in this species.

The first regular interradials are large, tumid plates, and, in one of the areas, the first one is followed by two elongated plates, that unite with two plates belonging to the vault, but, in the other two areas, the first one is followed by two plates in the second range and two smaller ones in the third range, that connect with two plates belonging to the vault. The first azygous plate is in line with the first primary radials, very tumid, and rather larger than either of them. It is followed by three plates in the second range, and these by two in the third range, that unite with the plates of the vault. The vault is elevated over the ambulacral canals, conical, and bears a large central proboscis, which is broken off in our specimen. The plates on the vault are polygonal, tumid and few in number.

This species cannot be compared with any other, unless it is for the purpose of showing that it is abnormal, and not entitled to a specific name It is four-fifths of a *Batocrinus*. It agrees with *Batocrinus* as far as it goes. The definition of *Batocrinus* requires five radial series, and this species has only four. The radial series that is missing is the one opposite the azygous area. Probably it will be found to be as near *B. incultus* as to any other species, but, aside from the four radial series, it will be noticed that the interradial and azygous areas and the vault and proboscis are quite different in the two species. Take from *B. incultus* one radial series and one interradial area and close up the opening, it will be found to be widely different from this species in general form and outline. The differences are even more marked when compared with *B. imparilis*, which has twelve ambulacral openings. We see no reason why a crinoid should not have perpetuated itself while having only four radial series as well as if it had six. The difficulty that is hard to overcome in this case is, if we have here a good species, we ought also to have a good genus, and yet we are unwilling to take it out of the genus *Batocrinus*. If our specimen is abnormal, it is well worth defining and illustrating, and the specific name we have given it will serve for a handle until some one has ascertained to what species it should be referred, and even then the synonymy will not have altogether lost its usefulness. We are of the opinion that our specimen descended from a *Batocrinus*, and, if we had two specimens, we would be confident that it could perpetuate itself and. therefore, rank as a species; but, if the single specimen is all that ever existed, we would say it is abnormal, and only proves the great vitality the species possessed, that gave it the strength to grow to maturity in the perfect form of its kind, while one-fifth of the body was absent from its birth or inception. Under all the circumstances, probably, the specific name should be received only provisionally.

Found in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS FORMACEUS, n. sp.

Pla'e I, Fig. 23, azygous view; Fig. 24, opposite view.

Species medium or above medium size. Calyx bowl-shaped, semi-elliptical, broadly rounded below; height two-thirds the diameter; no radial ridges; sutures distinct, not beveled; surface granular. Column small, round.

Basals form an hexagonal disc about twice as wide as the diameter of the column with an hemispherical columnar cavity radiately furrowed. First radials large, expanded, three hexagonal and two heptagonal. Second radials, quadrangular, a little wider than long. Third radials one-half larger than the second, pentagonal, except the one upon the left of the azygous area, which is hexagonal, and three of the rays support upon each upper sloping side two secondary radials, the last of which is axillary and supports upon each upper sloping side two tertiary radials which gives to each of these rays four arms. In one of the lateral rays there are upon one side three secondary radials and upon the other two secondary radials, the last being axillary and supporting upon each upper sloping side two tertiary radials, which gives to this ray three arms. In the ray opposite the azygous area the third primary radial supports, upon each superior side, three secondary radials, which gives to this ray two arms. There are, therefore. seventeen arm openings to the vault in this species.

The regular areas do not connect with the vault, except in the area between the two and three-armed rays and the number of plates in each varies from three to five. The azygous area is very large and contains fifteen plates. The first one is in line with the first primary radials and of the same size. It is followed by three plates in the second range, five plates in the third range, three in the fourth range and above these there are three plates two of which connect with the plates of the vault. Vault convex, composed of polygonal, convex plates and bears a strong subcentral proboscis.

This species is distinguished by its general form, absence of radial ridges, and seventeen ambulacral openings to the vault. It will also be distinguished by the number of plates in the azygous area, if that feature is of specific importance, but we have known the number of plates, in the azygous area, to vary, among specimens, that we have referred to the same species, and, probably, in this species some specimens may show a less number of plates, commencing with the five plates in the third range and continuing to the vault. We have seen two specimens besides the one illustrated, but the plates in the upper part of the azygous area are either not well preserved or are not to be distinguished from the type.

Found in the Burlington Group, at Sedalia, Missouri, and now in the collection S. A. Miller.

BATOCRINUS INCONSUETUS, n. sp.

Plate I, Fig. 25, basal view; Fig. 26, summit view; Fig. 27, azygous side view.

Species medium or below medium size. Calyx very low and saucer-shaped; height not more than one-fourth the diameter, and ambulacral openings directed horizontally; slight radial ridges, interradials plain; surface smooth. Column medium size and round.

Basals form a circular disc that projects below the first primary radials about the thickness of a plate, has a diameter about twice as great as the diameter of the column, and bears a concave, radiately lined depression for the columnar attachment. First primary radicals twice as wide as long, three hexagonal and two heptagonal. Second primary radials quadrangular, about three times as wide as long. Third primary radials a little larger than the second, twice as wide as long, pentagonal, axillary and in each lateral ray support upon each upper sloping side two secondary radials, the last of which is axillary and supports upon each upper side two tertiary radials which gives to each of these rays four arms. Upon the distal side of the third primary radials adjoining the azygous area there are four secondary radials, and on the proximal side two secondary radials, the last of which is axillary and bears upon the distal side two tertiary radials, and upon the proximal side three tertiary radials which arrangement gives to each of these rays three arms. In the ray opposite the azygous area there are three secondary radials upon each side of the third primary which gives to this ray two arms. There are, therefore, sixteen ambulacral openings to the vault in this species, and the last radials are small and contracted which makes it probable that the arms, which are not preserved, are single and not large.

There are three regular interradials in each area, one followed by two in the second range that are short and enclosed below the tertiary radials so that they do not approach the vault. The first azygous plate is in line with the first primary radials and somewhat longer, and it is followed, in the second range, by four plates that very much widen the lower part of the area. There are four plates in the third range and these are followed by a single narrow elongated plate that connects with the plates of the vault.

The vault is low and has about the same capacity as the calyx. It is covered with polygonal, convex plates and bears a small subcentral proboscis. The ovarian apertures are conspicuous in this species. There are two between each pair of arms and one between the secondary and tertiary series in the three-armed rays, which makes sixteen in the species. They are above the calyx and connect with the ambulacral canals under the vault.

This species is distinguished by its general form, sixteen arms, four azygous plates in the second range, short regular interradial areas, and ovarian apertures. It cannot be mistaken for any other described species.

Found by S. A. Miller in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS SERRATUS, n. sp.

Plate I, Fig. 28, basal view; Fig. 29, azygous side view; Fig. 30, summit view.

Species medium or below medium size, the one illustrated is the largest among four which are before us. Calyx nearly flat; height one-fifth or one-sixth the diameter, and ambulacral openings directed horizontally; radial series project at the margin so as to notch the circumference at the interradial parts, and they are somewhat lobed, without radial ridges; surface granular. Column round, medium size.

Basals form a subhexagonal disc, that projects below the first primary radials about the thickness of a plate, has a diameter about one-half greater than the diameter of the column, and bears a slight concave, radiately lined depression, for the columnar attachment. First primary radials twice as wide as long, three hexagonal, two heptagonal. Second primary radials quadrangular and from two to three times as wide as long. Third primary radials a little larger than the second, twice as wide as long, pentagonal, axillary and in each lateral ray support upon each upper sloping side two secondary radials, the last of which is axillary and supports upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. Upon the distal side of the third primary radials adjoining the azygous area there are three secondary radials, and on the proximal side, two secondary radials, the last of which are axillary and bear upon each superior sloping side two tertiary radials which gives to each of these rays three arms. In the ray opposite the azygous area there are three secondary radials upon each side of the third primary radial, which gives to this ray two arms. There are, therefore, sixteen ambulacral openings to the vault in this species.

The regular interradial areas are elongated and not uniform. In two of the areas one large plate is followed by one short small plate and one elongated plate that unites with two plates belonging to the vault. In another area there are two plates corresponding to the elongated plate just mentioned, and the last one unites with the plates of the vault, and in the other area there are only two plates, one following the other, and they are cut off by the third radials from uniting with the plates of the vault. The first azygous plate is in line with the first primary radials and somewhat smaller; it is followed by three plates in the second range and two in the third range, that unite with the plates of the vault.

The vault, though low, has more capacity than the calyx. It is covered with polygonal, convex plates and bears a small subcentral proboscis. The ambulacral areas are convex and the interambulacral areas abruptly depressed at the interradial areas, so that the vault presents the same notched margin that belongs to the calyx. There are sixteen ovarian apertures, but they are small and situated close to the ambulacral openings and not as far back upon the vault as in *B. inconsuetus*.

This species when compared with *B. inconsuetus*, that has the same number of arms, will be found to have quite different interradial and azygous areas and fewer plates in them; there are fewer tertiary radials in the rays, and the lobed rays and depressed marginal interradial areas serve at once to distinguish it, without touching upon minor differences, that will occur to any one who reads the descriptions. It is so different from all other described species that no comparison with any of them is necessary.

Found by S. A. Miller in the Keokuk Group, at Booneville, Missouri, and now in his collection.

BATOCRINUS IGNOTUS, n. sp.

Plate I, Fig. 31, basal view; Fig. 32, azygous side view; Fig. 33, summit view.

Species medium size. Calyx low, three times as wide as high and ambulacral openings directed horizontally. Radial series rounded, most strongly convex at the margin; interradial areas slightly concave, surface granular; column round, medium size.

Basals form a subhexagonal disc that projects below the first primary radials and has a diameter about twice as great as the diameter of the column; it bears a moderately concave, radiately lined depression for the columnar attachment. First primary radials of unequal size and a little wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular and about three times as wide as long. Third primary radials larger than the second, more than twice as wide as long, pentagonal, axillary, and in one lateral ray supports upon each upper sloping side two secondary radials, the last being axillary and supporting upon each upper sloping side two tertiary radials; in the other lateral ray there are three secondary radials, on each side of the third primary radial, the last of which are axillary and bear upon each superior side two tertiary radials, which gives to each of these rays four arms. Upon the distal side of the third primary radials, adjoining the azygous area there are three secondary radials, and on the proximal side two secondary radials the last of which are axillary and bear upon each superior sloping side two tertiary radials, which gives to each of these rays three arms. In the ray opposite the azygous area the third primary radial bears upon one side three secondary radials and upon the other two secondary radials, the last being axillary and supporting upon each upper side two tertiary radials, which gives to this arm three rays. It will be observed that this ray is constructed in the same way that the rays are on each side of the azygous area and that the side having three secondary radials is on the side of the lateral ray that has three secondary radials on each side of the third primary radial. This species, therefore, has seventeen ambulacral openings to the vault.

There are three regular interradials in each area; one large plate followed by two small ones. They are below the tertiary radials and do not reach near the vault. There are six plates in the azygous area. The first one is in line with the first primary radials and about the same size; it is followed by three plates in the second range, and two in the third, neither of which approaches the vault.

The vault is highly convex and has more capacity than the calyx. It is covered with plain, polygonal plates, and bears a rather large proboscis. The ovarian apertures are small and on the sides of the plates surrounding the ambulacral canals. There appear to be seventeen of them.

This species is distinguished by its general form and seventeen arms. If the three secondary radials, in one of the lateral rays, is to be regarded as a normal feature, then that alone will distinguish it from all other species. If we had two specimens of this species possessing three secondary radials, we would not hesitate to regard it as a normal feature, but having only one, it may be a strange freak that was not perpetuated.

Found by S. A. Miller in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS MODESTUS, n. sp.

Plate I, Fig. 34, basal view; Fig. 35, azygous side view; Fig. 36, summit view.

Species medium or just below medium size. Calyx subhemispherical, rather more than twice as wide as high, and broadly rounded below. Plates convex. No radial ridges. Surface granular. Column round, medium size.

Basals form an hexagonal disc that projects slightly below the first primary radials and has a diameter a little less than twice the diameter of the column; it bears a moderately concave, radiately lined depression for the columnar attachment. First primary radials about one-half wider than high, three hexagonal, two heptagonal. Second primany radials quadrangular, three or four times as wide as long. Third primary radials only a little longer than the second, and two or three times as wide as long, pentagonal, axillary, and in one lateral ray supports upon each upper sloping side two secondary radials, the last one of which is axillary and supports upon each upper sloping side two tertiary radials, which gives to this ray four arms. In the other lateral ray there are four secondary radials upon one side of the third primary radial and two upon the other followed by three tertiary radials upon each side, which gives to this ray three arms. Upon the distal side of the third primary radials adjoining the azygous area there are four secondary radials and on the proximal side two, the last being axillary and bearing upon each upper sloping side two or three tertiary radials which gives to each of these rays three arms. In the ray opposite the azygous area there are three secondary radials on each upper sloping side which gives to this ray two arms. There are, therefore, fifteen arm openings to the vault, in this species, but all the arms preserved in any of our specimens at once bifurcate, giving, as indicated, thirty free arms to the species. We have, however, only three specimens showing any of the arms, but one of them has five bifurcating rays showing part of ten arms. The general form and parts preserved leave little doubt that the species has thirty free arms.

There are three regular interradials in each area—one large plate followed by two small ones. They are below the tertiary radials and do not reach the vault. There are seven plates in the azygous area. The first one is in line with the first primary radials and of about the same size; it is followed by three plates in the second range, two in the third range and one in the fourth, which unites with the plates of the vault.

The vault is conoidal and has a capacity about equal to that of the calyx. It is covered with plain and slightly convex, polygonal plates, and bears a moderate-sized subcentral proboscis. No ovarian pores have been seen in any of our specimens and there appears to be no evidence of their existence.

This species is distinguished by its general form, hemispherical calyx and conoidal vault, fifteen ambulacral openings to the vault and thirty free arms. Any one capable of distinguishing a *Batocrinus* will at once know the species from these peculiarities.

Found by S. A. Miller, in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS HETEROCLITUS, n. sp.

Plate I, Fig. 37, basal view; Fig. 38, azygous side; Fig. 39, summit view.

Species rather below medium size. Calyx and vault subequal, and together somewhat trochiform. Height of the calyx about one third the diameter, and ambulacral openings directed horizontally. Radial series project at the margin, so as to notch the circumference at the interradial parts. Radial ridges well defined and angular. Surface granular. Column round and small.

Basals form an hexagonal disc or very low cup two and a half times the diameter of the column. First primary radials wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, and from two to three times as wide as long. Third primary radials only a little larger than the second, twice as wide as long, pentagonal, axillary, and in each lateral ray, and in the ray on the right of the azygous area support upon each upper sloping side two secondary radials, the last of which are axillary and support upon each upper sloping side two tertiary radials, which gives to each of these three rays four arms. The ray on the left of the azygous area bears on the distal side of the third primary radial three secondary radials, and on the proximal side two secondary radials, the last one being axillary and supporting, on each upper sloping side, a single tertiary radial, which gives to this ray three arms. The ray opposite the azygous area bears upon each upper side three secondary radials, which give to it two arms. There are, therefore, seventeen arm openings to the vault in this species.

The regular interradial areas are elongated and connected with the vault. The first plate is smaller than a first radial; it is followed by two plates in the second range, and, in some areas, with two plates in the third range that connect with the plates of the vault, and, in other areas, one plate in the third range connects with the plates of the vault. There are, therefore, four plates in some areas and five in other areas. The azygous area is large and connected with the plates of the vault. The first azygous plate is in line with the first primary radials and somewhat narrower; it is followed by three large plates in the second range, three smaller ones in the third range, and two in the fourth range, that connect with the plates of the vault. There are, therefore, nine plates in this area.

The vault is conoidal, low, depressed toward the margin in the interradial areas, and covered with polygonal, convex plates. There is doubt about the presence of a proboscis. The highest elevation is almost central and if a proboscis existed it must have been very small, for, at that place, the plates indicate a small orifice, without the upright plates that support a proboscis. We think no proboscis existed, in this species, and, therefore, we think, in *Batocrinus*, all the variations may exist on the vault, from no proboscis at all, to the balloon-shaped or to the most elongated and crooked forms that have been called *Eretmocrinus*. A few ovarian apertures may be distinguished, but they are very minute, and, adjoining some of the arms, there seems to be none at all; in fact, there are only two, one on each side of the azygous depression, that can be clearly distinguished.

This species will be distinguished, by its general form, connection of the interradial area with the vault, and by the seventeen ambulacral openings. The entire absence of a proboscis or the existence of a very short one is a feature also of some importance.

Found by S. A. Miller in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS PROCERUS, n. sp.

Plate I, Fig. 40, basal view; Fig. 41, azygous side view; Fig. 42, opposite view of same specimen.

Species medium size and capacity of the vault exceeding that of the calyx and belonging to those forms which are referred by authors to *Eretmocrinus*. Calyx broadly truncated below and obconoidal above, for a short distance, but becoming obpyramidal, in the region of the arms, by reason of a slight tendency toward lobes, in the radial series. No radial ridges. Width about one-half more than height. Plates moderately convex. Column round—not large.

Basals form an hexagonal disc more than one-half wider than the diameter of the column, with a concave, radiately lined depression below, for the columnar attachment. First primary radials wider than high. Second primary radials quadrangular, from two to three times as wide as high. Third primary radials about one-half larger than the second, more than twice as wide as long, pentagonal, axillary, and, in each series, except the one opposite the azygous area, bear upon each upper sloping side two secondary radials, the last one of which is axillary and supports upon each superior sloping side a single tertiary radial, which gives to each of these four rays four arms. In the ray opposite the azygous area there are, upon one of the superior sloping sides of the third primary radial, three secondary radials and upon the other two secondary radials, the last of which is axillary and bears upon each upper side, a single tertiary radial, which gives to this ray three arms. There are, therefore, nineteen arms in this species.

There are three regular interradials, in each area, one large followed by two smaller ones, below the tertiary radials, which abut against each other and cut off the area from any connection with the vault. There are seven plates in the azygous area. The first one in the line with the first primary radials and somewhat narrower; it is followed by three plates in the second range and two in the third and above these one plate that unites with the plates of the vault, as it appears in our specimen. Our specimen, however, is slightly injured about the top of this plate, so as to leave the sutures in doubt, and possibly an angle from the tertiary radials may separate it from the plates of the vault.

The vault is somewhat pyramidal in the lower part and conoidal above. On the azygous side there is a longitudinal, concave depression extending down to the azygous area of the calyx. The vault is covered with slightly convex, polygonal plates. The proboscis is large and central. There are no ovarian pores.

This species is distinguished by its general form and nineteen ambulacral openings to the vault. It is unnecessary to compare it with any other species that possessed the same number of ambulacral openings.

Found by S. A. Miller, in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS VICINUS, n. sp.

Plate II, Fig. 1, basal view; Fig. 2, azygous side view; Fig. 3, summit view.

Species below medium size, vault rather larger than the calyx, but, on the whole, somewhat trochiform. Height of the calyx less than half the diameter, and ambulacral openings directed horizontally. Radial series project at the margin so as to notch the circumference at the interradial parts. Radial ridges moderately well defined and angular. Surface, granular. Column round and small.

Basals form an hexagonal disc about one-half wider than the diameter of the column, and which extends, in a low rim, below the first radials. First primary radials wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, and about twice as wide as long. Third primary radials about twice as large as the second, and about twice as wide as long, pentagonal, axillary, and each one, adjoining the azygous area, bears on the distal side two secondary radials and on the proximal side two secondary radials, the last being axillary and supporting upon each upper side a single tertiary radial which gives to each of these rays three arms. Each lateral ray is constructed in the same manner and each bear three arms. In the ray opposite the azygous side the third primary radial bears upon each upper sloping side three secondary radials, which gives to this ray two arms. There are, therefore, fourteen arms in this species.

The interradial areas are elongated and the plates connect with those of the vault. The first plate is about the size of a first primary radial; it is followed by two small plates in the second range, and one or two in the third range, and these by one or two that connect with the plates of the vault. There are, in these areas, from five to seven plates. The azygous area is large and contains twelve plates. The first one is in line with the first primary radials and of about the same size; it is followed by three plates in the second range, four in the third range, and four in the fourth range, three of which connect with the plates of the vault.

The vault is highly convex centrally and depressed toward the margin, in the interradial areas, and covered with polygonal convex plates. A large plate occupies the central part of the vault, and adjoining it on the azygous side is a small azygous orifice directed upward. There is no proboscis, though the plates surrounding the orifice are elevated higher than the central plate. There are no ovarian apertures.

This species is distinguished by its general form and fourteen arms from all other species. By some it will be classed in the genus *Dorycrinus*, but we are not inclined to extend the genus *Dorycrinus* to include such species as this, for by so doing it will graduate into *Balocrinus*. In *Dorycrinus* there are large plates bearing spines on the vault, and the azygous area is altogether different from the regular interradial areas, and the orifice is directed laterally from a more or less bulbous protuberance, neither of which characters exist in this species. It is true, however, that, in some respects, this species is allied to *Dorycrinus*, and is widely different from the most typical *Batocrinus* in some respects, but the essential characters enable us, without hesitation, to refer it to the latter genus.

Found in the Keokuk Group, at Booneville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS INOPINATUS, n. sp.

Plate II, Fig. 4, basal view; Fig. 5, azygous side; Fig. 6, summit view.

Species below medium size. Calyx short, obconoidal, diameter more than twice the height. Radial ridges present, but not very well defined. Surface granular. Column round and quite small.

Basals form an hexagonal disc or very low cup that bears a rim below the first primary radials, and has a diameter about twice as great as the diameter of the column. First primary radials a little wider than long, three hexagonal, two heptagonal. Second primary radials, quadrangular, very short, between two and three times as wide as long. Third primary radials one-half larger than the second, three pentagonal, two hexagonal, axillary, and each one adjoining the azygous area bears, on the distal side, two secondary radials, and one of them bears, on the proximal side, a single secondary radial which is axillary, and bears upon each upper sloping side a single tertiary radial, and the other one bears, on the proximal side, two secondary radials, the last one of which is axillary, and bears upon one upper sloping side two tertiary radials, and upon the other, one, giving to each of these rays three arms. One of the lateral rays bears upon one of the superior sloping sides of the third primary radial three secondary plates, and upon the other two secondary radials, the last of which is axillary, and bears upon each upper side a single tertiary radial, which gives to this ray three arms. In the other lateral ray the third primary radial bears upon each upper sloping side two secondary radials, the last being axillary, and bearing upon the proximal sides one tertiary radial, and upon the distal sides two tertiary radials, which gives to this ray four arms. In the ray opposite the azygous area the third primary radial bears upon each upper sloping side three secondary radials, which gives to this ray two arms. There are, therefore, fifteen arm openings to the vault in this species.

The interradial areas connect with the vault, but they differ in form and in the number of plates. The first plate is about as large as a first primary radial. It is followed in one of the areas by a single plate, in two of the areas by two plates, and in one of the areas by three plates in the second range. In the third range in each case a single elongated plate connects with the plates of the vault. The azygous area is large, and contains ten plates. The first one is in line with the first primary radials, and is followed by three large plates in the second range. One of the lateral plates, in the second range, supports two small plates, and, over the middle plate, in the second range, there are two ranges of two plates each, one of the larger of which connects with the plates of the vault.

The vault is nearly flat, covered with slightly convex, polygonal plates, and bears a small subcentral proboscis. No ovarian aperatures can be distinguished.

This species is distinguished by its general form, flattened vault, peculiar interradial areas and fifteen arms.

Found by S. A. Miller, in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS PLANUS, n. sp.

Plate II, Fig. 11, basal view of a cast preserving elevated lines outlining the plates; Fig. 12, summit view of same specimen, but the outline of the plates is not preserved; Fig. 13, azygous side view of same; Fig. 14, basal view of another, perfectly preserving the plates, as far as illustrated.

Body very much depressed, pentagonal, capacity of the vault equal to or exceeding that of the calyx. Calyx very low, about four times as wide as high, concave in the region of the basals and gently rounding over the first radials toward the margin. Plates convex and radial ridges lobed above the first radials. Surface granular. There are pits at the angles of the larger plates in our specimen, but that character is not shown on either of two casts and may not, therefore, be normal. One cast is one-fourth larger than the specimen illustrated. It will be observed, that there is some difference, in the proportional size of the plates, and the depressions on the cast, this is because the internal sides of the plates are not like the external surface. It is for this reason, that we cannot always recognize the casts, when we are conversant with specimens having the plates well preserved, and it is, therefore, a matter of gratification to be able to illustrate a species preserved in both ways.

The basals form a small hexagonal, concave disc which is almost wholly covered with the column. The first radials are quite as long as wide and very slightly rounded from the basals to the second radials, three hexagonal, two heptagonal. Second radials quadrangular, about one and a half times as wide as long. Third radials one-half larger than the second, pentagonal, axillary and support upon each upper sloping side two secondary radials, the last of which are axillary and support the free arms. As near as can be ascertained, from our specimens, there are four arms in each series, which arise from the second secondary radials and are directed horizontally.

The interradial areas are wide and the plates connect with those on the vault. In each regular area there are three plates, one large followed by two elongated plates that unite with three plates belonging to the vault. There are seven azygous interradials, the first one heptagonal, in line with the first primary radials and of the same size. It is followed by three plates in the second range and three in the third range, which unite with four plates belonging to the vault. The vault is convex, and bears a subcentral azygous prominence, with the orifice on top, but whether or not there is a proboscis cannot be determined definitely from our specimens.

This species would be classed with *Steganocrinus* if it had hexago~~nal~~, second, primary radials. But, aside from the unusual, flattened, pentagonal outline, the calyx is that of a true *Batocrinus*. There is no species described in either genus, with which it is necessary to compare it.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS PRODIGIALIS, n. sp.

Plate III, Fig. 4, basal view; Fig. 5, azygous side; Fig. 6, summit view.

Species very large and wonderfully strong, nearly four times as wide as high. Exceedingly rough, by reason of the plates being produced in wedge-shaped, transverse nodes. The radial series are prolonged beyond the interradial areas leaving the circumference deeply notched between the arms. Column round at the calyx, large and pierced by a round columnar canal.

Basals short, projecting in cuneiform edges and expanding below the end of the column, and beveled at the sutures, so as to give the base an hexagonal outline. The basal disc is about twice as wide as the diameter of the column. The circle for the attachment of the column is only slightly concave and is radiately furrowed at the margin. First radials full twice as wide as high, three hexagonal, two heptagonal. Second primary radials, less than half as large as the first, quadrangular, and more than twice as wide as long. Third primary radials a little larger than the second, short, pentagonal, axillary and support on each upper sloping side two secondary radials, the last of which is axillary and bears the tertiary radials. In each of the radial series, there is upon one of the upper sloping sides of the last secondary radial a single tertiary radial which is axillary and bears upon each upper side quaternary radials, which gives to each ray five arms. In each radial series there are three or four tertiary radials and where the last tertiary radial is axillary there are upon each upper sloping side three quarternary radials. There are, therefore, twenty-five ambulacral openings to the vault. They are all directed horizontally so as to leave deeply notched interradial areas that connect with the vault.

Interradial areas elongated and covered with four plates. The first one is large and nearly as long as wide; it is followed by two plates in the second range and one in the third that connects with the plates of the vault. In the azygous area there are twelve plates. The first one is in line with the first primary radials and somewhat smaller; it is followed, in the second range, by three plates, in the third range by four plates, and in the fourth range by four plates that connect with the plates of the vault. There is some irregularity in the last range of plates and two of them are elongated and in part belong to the vault. The fact is, that there is no line directly separating the plates of the calyx, in this area, from those belonging to the vault.

Vault abruptly convex on the azygous side and highly convex on the other, so that the vault has two or three times the capacity of the calyx. The vault is not depressed in the interradial areas, but carries its convexity full to the margin of the interradial areas of the calyx. It is covered with large polygonal nodose plates and bears a large, subcentral proboscis.

The expanded basals and large subcentral proboscis will cause it to be classed with *Eretmocrinus*, by many authors. The union of the interradial areas with the vault is not a common character of *Batocrinus*, but this is not a special character ascribed to *Eretmocrinus*, and if it were, still it is a character possessed by many species of *Batocrinus*. On the whole, the quadrangular second primary radials ally it with *Batocrinus* so strongly, that we have no hesitation in referring it to that genus. It is in striking contrast with the *Batocrinus* figured on Plate I of this Bulletin, and shows the wonderful development of this genus. This species is distinguished from *B. yandelli*, which it most resembles, by having twenty-five instead of twenty-one or twenty-two arm openings to the vault, and by having one more regular interradial in each area and one or two more azygous plates. The calyx is not as high, though it is a larger species.

Found by Geo. K. Greene, in the Keokuk Group, at Button Mould Knob, Kentucky, and now in the collection of Wm. F. E. Gurley.

SHUMARDOCRINUS, n. gen.

This genus is founded upon the species described by Shumard, under the name ef *Actinocrinus concinnus*, in the Geo. Sur. of Mo. for 1855, page 189, and illustrated on plate A, figure 5. The generic formula is as follows: Basals, 3. Radials, 2 by 5. Regular interradials, 1. Azygous interradials, 3. Interradial areas connect with the vault without any distinguishing line of separation. Azygous orifice subcentral. No proboscis. Type *Shumardocrinus concinnus*.

The specific description given below may embody generic characters, but as we have only one species belonging to the genus, it is not easy to distinguish characters that are specific from those that are generic; and, it is not improbable, that another species may be found having a proboscis, and, if so, the presence or absence of a proboscis will dwindle to specific importance only. We refer the genus to the *Actinocrinidæ*.

SHUMARDOCRINUS CONCINNUS, Shumard.

Plate II, Fig. 7, basal view; Fig. 8, summit view; some of the plates are destroyed; Fig. 9, side view; Fig. 10, azygous side view.

This species was described in 1855 by Shumard in these words:

"The portion of the body of this species situated above the second radial pieces is unknown.

"The inferior part of the calyx is nearly hemispherical, and the plates moderately thick. Basal pieces, three, nearly equal in size, forming a low cup with a nine-sided border, and presenting beneath a wide, circular, shallow depression for the column. First radials, moderately convex, length and breadth nearly equal, three hexagonal and two heptagonal; inferior angle of heptagonal pieces corresponding with a basal suture. Second radials, wider than long, with the articular facets for third radials nearly perpendicular, large, reniform, occupying nearly half the length and two-thirds the width of each piece. First interradials, hexagonal, a little longer than wide, and rather larger than the second radials. First areal pieces, hexagonal, longer than wide, its inferior angle corresponding to a basal suture. Second areals, heptagonal, surface of the plates ornamented with prominent radiating ridges, which rise from near the center of the plates, and cross the sutures, so as to form several sets of double triangles around the body."

It will be observed, that Shumard thought he had only a fragment of the calyx, whereas he had, in fact, a complete calyx. He thought he had an *Actinocrinus*, as far as the second radials, and that the third radials had been broken away, but he had a new genus that never had any third radials.

Meek and Worthen described *Actinocrinus validus*, in 1860, in proceedings Acad. Nat. Sci. Phil. p. 384; but in 1866, in vol. 2 of the Geo. Sur. Ill., p. 200, referred it to *Actinocrinus concinnus*. Their species has but little resemblance, in any respect, to Shumard's, and it is not easy to understand why the two were ever confounded with each other. *Actinocrinus validus* must be restored, as a species, and as it is not a typical *Actinocrinus*, but approaches *Steganocrinus*, to which genus it has been referred by some authors, it may be known as *Steganocrinus validus*, Meek and Worthen.

We would describe this species from a specimen found in the Burlington Group, at Sedalia, Missouri, and illustrated in this Bulletin, as follows:

Calyx and vault subequal in capacity. Calyx pentagonal, three or four times as wide as high. Plates pyramidal and radiately sculptured. Column small and round.

Basals three and forming an hexagonal sculptured disck. First radials about as long as wide, three hexagonal and two heptagonal. Second radials about as large as the first, hexagonal and notched on the superior side by the ambulacral furrow. The articulating facets described by Shumard for the third radials are the articulating facets for the first plate in the free arms.

The first regular interradial hexagonal, smaller than the radials and succeeded by two smaller plates that abut upon the second radials and upon the ambulacral furrows and unite with three plates on the vault. The first azygous plate is in line with the first radials and of about the same size. It is followed by two plates, each of which is about the size of the first regular interradials. These plates abut the first plate on the sides of the ambulacral furrows, and are followed by three plates belonging to the vault.

The vault is convex and covered with highly convex and conical, polygonal plates. The azygous orifice is rather large and subcentral. The arms are unknown.

Found by R. A. Blair in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

MEGISTOCRINUS ORNATUS, n. sp.

Plate II, Fig. 15, basal view azygous side up; Fig. 16, azygous side view; Fig. 17, summit view.

Species medium or above medium size. Calyx subhemispherical, a little concave below, about twice as wide as high, not constricted below the arms. Surface delicately and ra diately sculptured from the central part of each plate, but without any central nodes or other elevations. Arm openings directed upward at an angle of about forty-five degrees. Column round, rather large and having a large, slightly cinque-foil canal.

Basal plates form an hexagonal disc about one-third wider than the diameter of the column. The first primary radials are the largest plates in the calyx, slightly unequal in size, not visible in a side view, those abutting on a single basal are heptagonal. The second primary radials are hexagonal, wider than long, differ somewhat in size, but smaller than the first. The third primary radials are slightly smaller than the second, the two adjoining the azygous are hexagonal, the other three are heptagonal. They are all axillary and bear the secondary radials. There is a single secondary radial on each upper sloping side of the third primary radials in the two rays adjoining the azygous area and in the ray opposite thereto. Each of these secondary radials are axillary and bear upon each superior sloping side two tertiary radials which gives to each of these three rays four arms. In the two lateral rays there are three secondary radials in each series which gives to each of these rays two arms. This arrangement gives to the species sixteen arms.

In each of the intersecondary areas that separate the three four armed series there are two plates, one following the other, the second one unites with the plates of the vault which throws the arms together in eight pairs. In each regular interradial area there are ten plates, the first one is hexagonal, rests between the upper sloping sides of the first primary radials, separates the second primary radials and is followed by two smaller plates in the second range, three in the third range, two in the fourth range and two in the fifth range, that separate the last tertiary radials and unite with the plates of the vault. The azygous area is large and contains twenty two plates. The first one is in line with the first primary radials and about as large; it is followed by three plates in the second range, five plates in the third range, four plates in the rourth range, four plates in the fifth range, three in the sixth range, and two in the seventh range that separate the last tertiary radials and unite with the plates of the vault.

The vault is highly convex in the central part and over the ambulacral channels and depressed toward the margin in the interambulacral areas. There is a large spine bearing plate in the center of the vault and one over the junction of the ambulacral canals in each of the five radial series. The other plates of the vault are polygonal, not tumid or spinous, but radiately sculptured after the manner of those forming the calyx. The plates are generally small and the sculpturing is so delicate and the sutures so indistinct that the artist found it impracticable to represent these characters in the illustrations. The azygous opening is large, subcentral, elevated and surrounded, at the base, with numerous small plates.

The general form and number of plates in the secondary and tertiary series will at once distinguish this species from ***M. expansus***, and it is so different from all other sixteen armed species, that no comparison with any of them is necessary. It is a marked and beautiful species.

Found in the Hamilton Group, in Clarke county, Indiana, and the one figured is now in the collection of S. A. Miller, while there are four specimens in the collection of J. F. Hammell, of Madison, Indiana, and many more than that in the collection of Wm. F. E. Gurley, varying from one-fourth the size of the specimen illustrated, to more than twice its dimensions.

MEGISTOCRINUS HEMISPHERICUS, n. sp.

Plate II, Fig. 18, basal view azygous side up; Fig. 19, azygous side view; Fig. 20, summit view.

Species medium size. Calyx subhemispherical, broadly flattened below, a little more than one-half wider than high, not constricted below the arms. Arm openings directed upward at an angle of forty-five degrees. Surface in our specimens apparently smooth, without any tumid plates, though as our specimens are silicified, the granules, if any, are destroyed. Column large and having a large canal. The sutures are nearly all obliterated, in our specimens, above the third primary radials rendering a technical description of the plates above the third primary radials impracticable.

The basal plates are substantially covered by the end of the column. The first primary radials are rather large, slightly unequal in size, directed from the column nearly horizontally, and those abutting on a single basal plate are hexagonal and those abutting upon two basals are heptagonal. The second primary radials are hexagonal, differ in size and are about as large as the first. The third primary radials are smaller than the first or second, three are pentagonal and two are hexagonal. They are axillary and bear the secondary radials. Two of the lateral rays have no tertiary radials and therefore have only two arms each. The ray on the left of the azygous area has four arms; the ray on the right of the azygous area has three arms and the ray opposite the azygous area has three arms. This arrangement gives to the species fourteen arms.

In the regular interradial areas there is one hexagonal plate separating the second primary radials, and two plates in the second range separating the third primary radials, each of which is about the size of the primary radials; above these plates the sutures are not distinct. The azygous area is large and protuberant, at the third and fourth ranges of plates. The first azygous plate is in line with the first primary radials and nearly as large; it is followed by three plates in the second range and by five plates in the third range, all of which are subequal in size; above these plates the sutures are not distinct in our specimen, but there seems to be five plates in the fourth range.

The vault is only moderately convex over the ambulacral areas, and rather slarply depressed toward the margin in the interambulacral areas. There is a tumid plate in the center and an azygous opening adjoining it. The sutures are destroyed in our specimen. There are no spinous plates over the ambulacral canals. This species is distinguished by its general form and fourteen arms.

Found in the Hamilton Group, in Clarke county, Indiana, and now in the collection of Mr. J. F. Hammell.

ACTINOCRINUS ALBERSI, n. sp.

Plate II, Fig. 21, azygous side; Fig. 22, apposite view; Fig. 23, summit view.

Species medium or above medium size. Calyx obconoidal, from one-third to one-half wider than high; plates convex and the larger ones sculptured so as to be more or less pyramidal, angles slightly depressed. No radial ridges. Column medium size.

Basals very short and project almost their entire length below the end of the column. They are beveled at the sutures so as to give the base a subhexagonal outline. The cicatrix for the attachment of the column is nearly or quite flat. First radials wider than long, three hexagonal, and two heptagonal, widening from the base to the lateral angles and contracting above. Second radials from one-fourth to one-half smaller than the first, hexagonal, and wider than high. Third primary radials a little smaller than the second, pentagonal, axillary, and support on each upper sloping side a single secondary radial, which is axillary, and, in three of the rays, support on each upper sloping side a tertiary radial, which gives to each of these rays four arms. In each ray adjoining the azygous area, there is, on the distal side of each third primary radial, a secondary radial, that supports upon each upper sloping side a single tertiary radial; but the secondary radial on the proximal side of the third primary radial bears upon its distal side an axillary tertiary radial, that bears upon each upper sloping side a quarternary radial, and upon its proximal side two tertiary radials, which gives to each of these two rays five arms. There are, therefore, twenty-two ambulacral openings to the vault, in this species.

The regular interradial areas do not connect with the plates of the vault. In each of three of the areas there are five plates, one, followed by two in the second range and two in the third range; but in the other area there are six plates, one, followed by two in the second range, and two in the third range, and one small plate, in the fourth range. We do not suppose, however, that this slight difference, in the interradial areas, is of specific importance, and describe it only because our specimen is so constructed. The azygous area connects with the vault and contains eleven plates. The first one is in line with the first primary radials though much smaller; it is followed by two plates in the second range, one of which is larger than it is. There are four plates in the third range that gives to the area a width nearly as great as the length. There are three plates, in the fourth range, that are followed by a single plate in the fifth range, that connects with a singe plate belonging, at least in part, to the vault. An ovarian pore is at a lateral angle of the last mentioned plate, which shows that it should be classed with the vault plates rather than with those of the calyx. There is a single, small, intersecondary plate in the area between the two arms and the three arms in each ray adjoining the azygous area.

The vault is elevated above the ambulacral openings, convex, and bears a central proboscis. It is covered by numerous polygonal, convex or spinous plates. It is not concave in the regular interradial areas, but is concave toward the margin in the azygous area. There are fourteen ovarian apertures, two separating the two arms from the three arms belonging to each ray adjoining the azygous area and two between the ambulacral openings belonging to each of the five radial series.

The specimen upon which this species is founded was collected by R. A. Blair, at Sedalia, Missouri, and was presented by him to S. A. Miller, among other fossils from the Chouteau limestone of that locality, several years ago. It has the light lead color of the Chouteau fossils and that of light yellowish color of the fossils from the Burlington Group of that locality. Were it not the color of the fossil itself, we might suppose that it is from the Burlington Group, and that it had accidently fallen in with the Chouteau fossils. But the rock is evidently the same as that in *Actinocrinus* (?) *Chouteanensis*, collected by Mr. F. A. Sampson and in other crinoids described from the Chouteau limestone of Sedalia. It does not seem to have any near affinity with any other crinoid from rocks of the age of the Chouteau, nor is it near enough specifically, to any described form from the Burlington Group to require any comparison for the purpose of pointing out differences. We have no doubt that it is from the Chouteau Group. The specific name is in honor of Mr. A. Albers, of Cincinnati, Ohio, who did the drawing for this bulletin, and who is a good palæontologist as well as an excellent artist.

STROTOCRINUS BLAIRI, n. sp.

Plate II, Fig. 24, lateral view, some of the sutures obscure at the canopy.

Species medium size. Calyx below the canopy obpyramidal, truncated little, if any, beyond the size of the column, width about one-half more than the height. Plates convex, the larger ones bearing a central node, from which the plates are radiately sculptured. Radial ridges on the lower side of the canopy or projecting summit, but not distinguishable below the third primary radials.

Basals form a very low cup or rim more than four times as wide as high; sutures beveled; facet for the attachment of the column concave. First primary radials a little wider than high, three hexagonal, two heptagonal. Second primary radials about half as large as the first, wider than long, hexagonal. Third primary radials nearly as large as the second, wider than long, heptagonal and supporting on each upper sloping side a single secondary radial, which is axillary and supports on each upper sloping side the tertiary radials. As far as the sutures can be determined in our specimen, where there is a single tertiary radial in any series, it is axillary and bears quaternary plates, but where there are two or more tertiary plates in the series the last one is not axillary. The rays on each side of the azygous area have each six arm openings to the vault, and one of the lateral rays has the same number and the other two rays as far as preserved indicate the same number. It is, therefore, believed, that there are thirty arm openings to the vault.

The regular interradial areas are elongated and cut off from the vault by the tertiary and quaternary plates. There are eight plates in each area, one in the first range, two in the second, two in the third, two in the fourth and one in the fifth. The azygous area is also cut off from the vault by the quaternary plates. The first plate is in line with the first primary radials and nearly as large, it is followed by two plates in the second range, four in the third, four in the fourth and above these there are three or more small plates but the sutures are too indistinct in our specimen to definitely determine the number.

The vault is quite convex and bears a central proboscis. It is covered with numerous, highly convex, polygonal plates.

This species is so well marked that it is unnecessary to compare it with any hitherto described.

Found in the Burlington Group, at Sedalia, Missouri, by R. A. Blair, in whose honor we have proposed the specific name, and now in the collection of S. A. Miller.

ACTINOCRINUS FOVEATUS, n. sp.

Plate II, Fig. 25, azygous side; Fig. 26, view opposite the azygous area of another specimen, the calyx is a little flattened in both specimens.

Species medium size. Calyx obconoidal, more rapidly spreading in the upper part than below, especially in the region of the secondary and tertiary radials; about one-half wider than high; plates convex, sculptured, more or less stellate; radial ridges angular in the superior part, and angles of the plates depressed.

Basals short, slightly constricted above; sutures beveled; columner cavity broad and shallow. First radials rather wider than long, except the radial on the left of the azygous area, which is longer than wide, three hexagonal, two heptagonal. Second primary radials about half as long as the first, hexagonal, and wider than high, except in the ray on the left of the azygous area, where the second radial is heptagonal and longer than wide. In this ray there is no third primary radial and the second occupies the position of the second and third primary radials. This feature may be abnormal, but as the first plate is larger than it is in either of the other rays the peculiarity must have commenced with the commencement of the growth of the specimen and is not due to any injury that it could have received. The fact that *Shumardocrinus* never had but two primary radials in any of its rays leads one to believe, that, in this species, one of the rays, in its normal condition, may never have had more than two. While we have two specimens of this species this particular ray happens to be wholly preserved in only one of them. Third primary radials, in the four rays, a little larger than the second, three of them pentagonal, and the one on the right of the azygous area hexagonal, as shown in both of our specimens; all are axillary, and support on each upper sloping side a single secondary radial, which is axillary and supports upon each superior sloping side a single tertiary radial, except in the ray on the left of the azygous area, where there are two tertiary radials. This peculiarity in the ray having only two primary radials does not appear to be abnormal, and certainly is not the result of any mechanical injury. There are, therefore, twenty ambulacral openings to the vault.

In one of the regular interradial areas adjacent to the ray opposite the azygous area there are six plates, one of which connects with the plates of the vault, and in the other area there are seven plates, one of which connects with the plates of the vault. In the other two regular areas there are only five plates, neither of which reaches the plates of the vault, because the areas are cut off by the union of the tertiary radials. The azygous area contains nine plates. The first one is in line with the first primary radials and somewhat smaller; it is followed by two plates in the second range, five plates in the third range, and only one in the fourth range which is cut off from the vault by the union of the tertiary radials above it.

Vault very convex and having more capacity than the calyx. It is covered by large, polygonal, spiniform plates. The vault is injured at the summit in both of our specimens so the character of the proboscis cannot be determined. No ovarian pores discovered.

This species, in some respects, resembles a *Batocrinus*, but the hexagonal, second primary radials must place it in the genus *Actinocrinus*. The fact that the azygous area and the two interradial areas adjoining do not connect with the vault, while the other two interradial areas do, would seem to be of specific importance, without reference to the want of uniformity in the number of plates, in the different areas. The ray on the left of the azygous area, if normal, will distinguish this species from all others and as the ray on the right is the same in each specimen we think the one on the left is normal. The general form and surface ornamentation will distinguish this from all other species having twenty arm openings to the vault, though it resembles *A. fossatus* which has forty arm openings to the vault.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

SAMPSONOCRINUS, n. gen.

[Ety. *The generic name is intended as a compliment to a distinguished naturalist, Mr. F. A. Sampson, of Sedalia, Mo.*]

Body more or less globose. Basals three, subequal, one pentagonal, two hexagonal. Primary radials either two or three in each radial series and differing in this respect in the different radial series in the same specimen. Secondary and tertiary radials present. Interradial plates connect with those of the vault, and, in three of the areas the first plate abuts upon the basals, by which arrangement eight plates unite with the basal disc. Vault elevated over the ambulacral canals, and depressed in the interradial spaces. Proboscis subcentral. Type *S. hemisphericus*.

We refer this peculiar genus to the family Actinocrinidæ.

SAMPSONOCRINUS HEMISPHERICUS, n. sp.

Plate III, Fig. 7, basal view; Fig. 8, summit view; Fig. 9, azygous side, the sutures between some of the plates being obscure; Fig. 10, lateral view.

General form of the calyx hemispherical, rather more than one half wider than high, broadly rounded below. Plates convex. Surface granular. Columnar facet very small. Arms directed horizontally.

One of the basal plates is pentagonal and two hexagonal, and they differ but little in size. When united they form a disc having three re-entering angles, in one of which an azygous plate is supported, and each of the others support, a radial series. The pentagonal plate is truncated by a radial and the hexagonal plates are truncated by a radial and by an interradial. By this arrangement the basal plates, when united, form a disc having eleven sides and abuts upon eight plates, a peculiarity we have never observed in any other fossil.

The first primary radials are longer than wide, very unequal in size, two pentagonal, two hexagonal, and one heptagonal. The radial series are so different that we will describe them separately. The first primary radial that truncates the pentagonal basal plate is the largest plate in the body, heptagonal, and has a width greater than its length. It is followed by a second primary radial, one-half smaller than the first, longer than wide and heptagonal. This is followed by a short, small, third primary radial that is heptagonal, axillary and supports upon each superior sloping side a small secondary radial, which gives to this ray two arm openings that enter the vault horizontally. In one of the series, supported in one of the re-entering angles of the basal disc, the first primary radial is very large and hexagonal. It is followed by a second primary radial, that is very large, wider than long, heptagonal, axillary, and supports on one of the superior sides a single, secondary radial, which is axillary and supports tertiary radials, and upon the other two secondary radials, the last of which is axillary and supports tertiary radials, which gives to this ray four arm openings to the vault, that are directed horizontally. In the other series supported in a re-entering angle of the basal disc, the first primary radial is much smaller than the one last described, longer than wide and pentagonal. It is followed by a second primary radial much larger than itself, wider than long, having eight sides, axillary and supporting, on the left lateral side a single secondary radial that is axillary and supports tertiary radials, and, on the superior side, a single secondary radial that is not axillary, and, on the right lateral side, a secondary radial that is axillary and supports tertiary radials, which arrangement gives to this ray five arms. It will be noticed here, that the two radial series supported in the re-entering angles of the basal disc have no third primary radials. In the radial series, on the right of the azygous area, the first primary radial is large, longer than wide, hexagonal, and followed by a second primary radial, which is much smaller, hexagonal, and followed by a third primary radial, which is still smaller, much wider than long, hexagonal, axillary, and bears upon each superior side a single secondary plate, which is short and axillary and bears tertiary radials, which gives to this ray four arm openings to the vault. In the radial series, on the left of the azygous area, the first primary radial is small, longer than wide, pentagonal, and followed by a second primary radial, nearly as large, longer than wide, hexagonal, and followed by a third primary radial, much wider than long, octagonal, axillary, and bearing on the superior sloping sides a single secondary radial, which is axillary and bears tertiary radials, which gives to this ray four arm openings to the vault. It will be observed that the three radial series that truncate the basal disc have, each, three primary radials, though the plates differ in relative form and size. There are, therefore, nineteen arm openings to the vault. The first arm plates are small, and the arms are directed horizontally. Beyond this, the arms are unknown.

The interradial areas differ, in form, and in the number of plates, and in position, as much as the radial series do, and, though they all connect with the vault and the plates grow less in size, until they unite with the plates of the vault, they will be separately described. In the area on the right of the azygous area, the first plate rests on the basal disc. It is large, longer than wide, hexagonal and is followed by two rather large plates in the second range, and five in the third range, which connect with the plates of the vault, but in this species there is no line separating the plates, in the interradial areas, from the vault, as they all graduate into each other. In the area on the left of the azygous area, the first plate rests on the basal disc. It is large, much longer than wide, heptagonal, and is followed by two plates, in the second range, that unite with three plates which belong to the vault. In the area on the right of the radial series that truncates the pentagonal plate belonging to the basal disc, the first interradial rests between the superior lateral sides of the first primary radials. It is moderately large, hexagonal, and is followed by two plates in the second range that unite with three plates belonging to the vault. In the area on the left of the radial series that truncates the pentagonal plate belonging to the basal disc, the first interradial rests between the superior lateral sides of the first primary radials. It is not as large as the corresponding plate last described, pentagonal and is followed by a single plate, in the second range, that unites with three plates belonging to the vault. This is the smallest of the interradial areas and has only two plates in it. In the azygous area as usual in the *Actinocrinidæ*, the first plate enters one of the re-entering angles of the basal disc, and is in line with the first primary radials. It is longer than wide, hexagonal and followed by two smaller plates, in the second range, three in the third, and four in the fourth, which unite with the plates of the vault in a zigzag line, without any definite mark of separation.

The vault is convex, having the radial areas highly and narrowly elevated with abruptly descending, wide interradial areas. It is covered with numerous, rather small, convex, polygonal plates. It had a small, subcentral proboscis, which is broken off in our specimen, at the summit of the vault

Found in the Chouteau limestone, at Sedalia, Missouri, by Mr. F. A. Sampson, and now in his collection.

AMPHORACRINUS SEDALIENSIS, n. sp.

Plate V, Fig. 34, summit view of a small specimen; Fig. 35, azygous side of a large specimen; Fig. 36, basal view of same; Fig. 37, summit view of same.

Species from medium to large size. Calyx semi-elliptical, or bowl-shaped, one-fourth wider than high, broadly rounded below. Interradial areas depressed between the arm bases where they unite with the plates of the vault. Plates convex, sculptured, more or less stellate. No radial ridges. Column round, medium size, and facet for attachment only slightly concave.

Basals short, and forming an hexagonal disc only about one-half wider than the diameter of the column. First radials a little wider than long, three hexagonal, two heptagonal. Second primary radials about two-thirds as large as the first, longer than wide, hexagonal. Third primary radials short, much smaller than the second, pentagonal, axillary and support on each upper sloping side a single secondary radial.

The secondary radials are directed nearly horizontally and stand out, their full length, from the interradial areas. There are ten arm openings to the vault.

There are three regular interradials in each area. The first one is as large as a second primary radial and reaches about as high, hexagonal, and supports two rather large plates that unite with the plates of the vault. There are nine plates in the azygous area. The first one is in line with the first primary radials and nearly as large. It is followed by two plates, equally as large, in the second range. There are four plates in the third range, though one of them touches one of the plates of the second range only at an angle, and on each side of the superior part there is a single plate. The last three plates unite with the plates of the vault.

The vault is highly elevated over the ambulacral canals and correspondingly depressed interradially. It is covered with numerous convex, polygonal plates and bears a large sub-central proboscis.

There is no described species very closely resembling this one, though we have no doubt that we have before us a true *Amphoracrinus*.

The large specimen illustrated was found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and is now in the collection of S. A. Miller. The smaller specimen is from the same rocks and is in the collection of F. A. Sampson. The sculpturing is best preserved on the smaller specimen.

FAMILY MELOCRINIDÆ.

MELOCRINUS SAMPSONI, n. sp.

Plate II, Fig. 27, basal view; Fig. 28, azygous side; Fig. 29, opposite view.

Species above medium size. Calyx obconoidal, as far as the secondary radials, which are directed horizontally, so as to give the summit a pentagonal outline; truncated by large column; diameter nearly twice as great as the height. Plates highly convex and more or less radiately sculptured.

The four basals form a short rim, which is slightly lobed by the depression of the suture lines, and almost covered below by the end of the column. First radials the largest plates in the calyx, a little wider than high, three heptagonal, two hexagonal. Second primary radials about half as large as the first, wider than high, four hexagonal, one pentagonal. They differ somewhat in size. Third primary radials smaller than the second, the superior part directed nearly horizontally; three pentagonal, two hexagonal, axillary, and support on each upper sloping side a single secondary radial. The secondary radials are short and directed horizontally, and the articulating facets are quite concave, and each one is marked by a large ambulacral notch. There are only ten ambulacral openings to the vault.

There are five plates, in each regular interradial area. The first one is about as large as a second primary radial, it is followed by two smaller plates, in the second range, and these by two plates, in the third range, that separate the secondary radials and curve in upon the vault to unite with the plates of the vault. There are ten plates in the azygous area. The first one is in line with the first primary radials and of about the same size; it is followed by two plates in the second range, three in the third range, and four in the fourth range, that curve in upon the vault to unite with the summit plates.

The vault is unknown.

This species is so radically different from all others that have been described, that no comparison with any of them is necessary.

Found by Mr. F. A. Sampson, the well known and prominent naturalist, in the Chouteau limestone, at Sedalia, Missouri and now in his collection. The specific name is in honor of the collector.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS NODOSUS, n. sp.

Plate III, Fig. 1, basal view; Fig. 2, azygous side view; Fig. 3, summit view.

Species above medium size. Calyx hemispherical, broadly truncated below. No radial ridges. Each plate bears a prominent conical central node, from the base of which there are numerous, more or less interrupted radiating lines, and toward the upper part, irregular, low, scattering nodes. Column round and having a large cinque foil columnar canal.

Basal plates almost covered by the column. First primary radials wider than long, the two on the azygous side being somewhat larger than the others. Second primary radials about one half wider than long, quadrangular. Third primary radials expand slightly to the superior lateral angles, longer than the second, pentagonal, axillary, and in the ray on the right of the azygous area bears a single, secondary radial upon each superior, sloping side, which is axillary, and bears upon each superior sloping side two tertiary radials, which gives to this ray four arms. In each of the other four rays, the third primary radial bears upon one upper sloping side three secondary radials, and upon the other, one secondary radial, which is axillary, and supports upon each upper sloping side, two tertiary radials. This arrangement gives to each of these rays three arms. There are, therefore, sixteen arms and sixteen ambulacral openings to the vault in this species.

The azygous area is like the others, except a little larger. The first interradials are the largest plates in the calyx, have nine sides, and are broadly truncated above for the second interradials. The second interradials are about half as large as the first, and are followed by a single plate, which is about half as large as the second, and unites with two large, elongated plates belonging to the vault.

The vault is very slightly elevated over the radial areas, and about equally as much depressed in the interradial areas. It is substantially covered by three circles of plates, the surface of which is covered by granules. and a few of the plates over the radial areas bear a small central node, as shown in the illustration. The subcentral azygous opening is slightly elevated and surrounded by four plates, two of which form part of the first circle of plates and, if counted with the first circle, there are seven plates in the first circle, and without them there are only five; but the circle is not complete without counting one of them. In the second circle there are seven plates. In the third circle there are fifteen plates, two in each depressed interradial area that unite with the plates of the calyx and one over each radial area. These are all the plates covering the vault except those over the radial areas at the base of the arms. There are no ovarian openings, at least, in a beautifully preserved specimen none can be discovered.

This species bears more resemblance to *Dolatocrinus bellulus* than to any other, but is readily distinguished by having only sixteen instead of seventeen arms, and by having no ovarian openings. There is also some difference in the convexity and structure of the vault and in the surface ornamentation.

Found in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Mr. J. F. Hammell, of Madison, Indiana.

DOLATOCRINUS SACCULUS, n. sp.

Plate III, Fig. 11, basal view; Fig. 12, side view.

Species medium or below medium size. Calyx subhemispherical, broadly truncated at the base and subcylindrical above. Radial ridges consisting of small, rounded elevations, which are interrupted by central nodes on the plates. Surface ornamented with radiating ridges from the central part of the plates that do not unite with the radial ridges or coalesce with the central nodes. The radiating ridges are toward the margin of the plates, and the second interradials have no central nodes. Column round, medium size, and having a large cinque foil canal.

Basal plates hidden by the column and a rounded flanging rim that surrounds it, on the basals and at the commencement of the first primary radials. First primary radials a little wider than long, and subequal in size. Second primary radials rather less than twice as wide as long, quadrangular, sides nearly parallel. Third primary radials very little larger than the second, from one-half wider to twice as wide as long, pentagonal, axillary, and bear upon each superior sloping side a single secondary radial. The secondary radials bear upon each superior sloping side a single tertiary radial, which gives to this species twenty ambulacral openings to the vault.

The first interradials are rather large and have nine sides. There is only a single plate in the second range and it extends to the top of the calyx and connects with the plates of vault. The azygous area is not materially different from the other areas.

The vault is moderately convex and bears rather sharp radial ridges. The sutures cannot be distinguished in our specimen. There are twenty ovarian apertures, one on each side of each pair of arms. They are elongated and are close to the ambulacral canals, and not through the vault itself as in some species.

This species, when compared with *D. corporosus*, will be found to have only a single tertiary radial, while in that species there are four, and only two interradials, while in that species there are from three to six plates, and the azygous area is altogether different. There are also some minor differences in surface ornamentation and otherwise. There is no necessity for comparing it with any other known species.

Found by Geo. K. Greene, in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS SALEBROSUS, n. sp.

Plate III, Fig. 13, basal view; Fig. 14, side view; Fig. 15, summit view.

Species medium or below medium size. Calyx subhemispherical, concave below and slightly constricted below the arms. Radial ridges consisting of small, rounded elevations which are interrupted by central nodes on the plates. Surface ornamented with radiating ridges from the nodes and central part of the plates. The second interradials have a transverse central ridge with longitudinal ridges below it. Column round medium size, and nearly filling the funnel-shaped cavity formed by the basal plates.

Basal plates form a cup that is inserted into the cavity of the calyx and is nearly filled by the end of the column. The mouth of the cup is about one-fourth wider than the diameter of the column. First primary radials about as long as wide and curve, at the lower end, into the basal concavity to unite with the basal plates, and upward at the superior end, so that the calyx will rest upon the middle part of these plates. Second primary radials from one-fourth to one-half wider than high, quadrangular, and slightly expanding upward. Third primary radials a little larger than the second, about one-half wider than high, three hexagonal, two pentagonal, axillary, and, in two of the rays, bear upon each upper sloping side a single secondary radial which is axillary and bears upon each superior side two tertiary radials, which gives to each of these rays four arms. In each of two other rays, the third primary radial bears upon one superior sloping side two secondary radials and, upon the other, a single secondary radial, which is axillary and supports, on each superior sloping side, two tertiary radials, which arrangement gives to each of these two rays three arms. The other ray, in its normal condition, may be like the last two, and if so, the species will have seventeen arms, but in the specimen illustrated, it is different and is peculiarly constructed, as follows. Upon one side of the third primary radial there is a single secondary radial, which is axillary and bears upon each superior side a single tertiary radial, and, upon the other side of the third primary radial, an interradial is supported, without the intervention of a secondary radial, and, therefore, there are only two arms to this ray, which gives us only sixteen arms in the specimen illustrated, and, until it can be shown, that this structure is abnormal, the species must be regarded as possessing only sixteen arms.

The first interradials are of unequal size, one of them is heptagonal and each of the others has nine sides. The heptagonal plate is followed by two plates, in the second range, one of which rests, in part, on one of the superior sides of a third primary radial and takes the position of a secondary radial in the two-armed ray. These two plates in the second range connect with two plates belonging to the vault. In the other four areas, one plate, in the second range, is followed by one in the third range that unites with two plates belonging to the vault.

The vault is moderately convex over the ambulacral canals and correspondingly depressed in the interradial areas. It is covered by a few rather large polygonal plates that bear pustules, and each one over the junction of the ambulacral canals bears a central node. The azygous orifice is central. No ovarian pores can be distinguished.

We regard the interradial area having the first plate heptagonal as the azygous area, and, if the two-armed ray is abnormal and the species has seventeen arms, then it will resemble *D. aurealus*, from which it will be readily distinguished, by the interradial areas; for in that species, there are three plates, in the third range, that unite with the plates of the vault, in the regular areas, and four or five in the azygous area. Besides, the ornamentation is different in the two species, and the proboscis in that species is large and subcentral and the arrangement of the plates on the vault is quite different in the two species. But if the two-armed ray is normal then this is a sixteen armed species so different from all other sixteen armed species that have been described, that no comparison with any of them is necessary.

Found by Geo. K. Greene, in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY POTERIOCRINIDÆ.

POTERIOCRINUS BLAIRI, n. sp.

Plate IV, Fig. 1, azygous view, the arms on the right a little compressed; Fig. 2, view showing the ray opposite the azygous area on the left, one of the arms is spread out of place.

Species medium size, robust, and having wide arms that fit closely together as in *Zeacrinus*. Calyx obconoidal, nearly twice as wide as high, truncated below for a rather large column; sutures distinct; surface smooth.

Basals very short, three or four times as wide as high. Subradials wider than high, three haxagonal, and two heptagonal; those adjoining the azygous area are heptagonal.

First radials of unequal size, but about twice as wide as high; truncated the entire width above and separated from the first brachials or arm plates by a slightly gaping suture. The second radials or brachials, as they are usually called, are of unequal size and not uniform in shape. In four of the rays these plates are wider than high, pentagonal and support upon each upper sloping side the secondary radials or free arms. The secondary radials are short, wide, quadrangular and abut against each other. In one of the series, the fifth plate is pentagonal, axillary and supports upon each upper sloping side the tertiary radials; in the other series, preserved in our specimen, the sixth plate is axillary, pentagonal and supports on each upper sloping side the tertiary radials. No further bifurcation is shown, though ten tertiary radials are preserved. The tertiary radials are short, wide, quadrangular, and abut against each other, in the same manner that the secondary radials do. This arrangement gives to each of these four rays four arms. In the ray opposite the azygous area, the second primary radial is the largest plate in the body and nearly square. It is followed by a short, quadrangular plate, and then follows a short pentagonal plate, that is axillary and supports upon each upper sloping side a long series of short, wide, quadrangular, secondary radials, which gives to this ray two arms. There are, therefore, eighteen compact arms in this species.

The azygous area is of moderate size and the plates are arranged as is usual in this genus. The first one is pentagonal and rests between the sloping sides of two subradials and below the under sloping side of the first radial, on the right. The second plate is long, hexagonal, truncates a subradial and reaches as high as the top of the second radial on the left. The fourth plate is much smaller than the third, truncates the second and extends a little beyond the third. The fifth plate truncates the third and is not fully exposed in our specimen.

This species is readily distinguished by its general form, and, so far as known, has no nearly related species, in the group of rocks, in which it occurs.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of the collector.

POTERIOCRINUS ALTONENSIS n. sp.

Plate IV, Fig. 3, azygous area on the right, calyx arms and part of the column, compressed; Fig. 4, opposite view of same specimen.

Species quite small, constricted above the calyx in the middle of the second radials or brachials. Calyx short, hemispherical or bowl-shaped, nearly twice as wide as high; plates convex; sutures distinct; surface granular. Column quite small and round, the alternate plates slightly projecting.

Basals depressed and extending a little beyond the column, so as to be seen from a basal view. Subradials rather wider than long and forming, with the basals, a low cup. First radials wider than long, pentagonal, truncated the entire width above and separated from the second radials or brachials by a gaping suture. A single, elongated, brachial or second radial, rounded and contracted in the middle, and axilliary, supports upon its superior sloping sides, in each radial series, the free arms. The arms are long, slender, round and composed of rather long plates which are slightly constricted in the middle part. The first plates are longer than the succeeding ones. The arms do not bifurcate and there are, therefore, only ten arms in this species. Pinnules distant.

Azygous plates are as usual in this genus; the first one is pentagonal, about half as large as a subradial, rests upon the upper sloping sides of two subradials and between the first radial, on the right, and the second azygous plate, on the left, and is truncated, at the top, for the third azygous plate; the second plate is pentagonal, about as large as the first, rests upon the truncated upper end of a subradial, and between a first radial, on the left, and the first and third azygous plates, on the right, and is truncated at the upper end, for the fourth plate. The fourth plate extends beyond the third.

This species is distinguished by its small size, hemispherical calyx, long, constricted brachials and ten arms. When compared with *P. rowleyi* it will be noticed, that species has two brachials, in some of the rays, and all the arms bifurcate toward the top. It will not be mistaken, for any other species, by any one capable of making a comparison.

Found by the late Hon Wm. McAdams, who was a prominent naturalist, in the St. Louis Group, at Alton, Illinois, and now inthe collection of S. A. Miller.

POTERIOCRINUS BROADHEADI, n. sp.

Plate IV, Fig. 7, azygous side view; Fig. 8, lateral view.

We have examined six specimens belonging to this species, one a third larger than the specimen illustrated, three others as much smaller, and each one is longer and larger upon the azygous side than upon the opposite side, showing the unsymmetrical form of the calyx is normal. Calyx irregularly obconoidal above the broad truncated base, by reason of the longitudinal convexity of the plates and the depressed sutures, or it might be called somewhat obpyramidal. The azygous side is longer than the other, the two rays opposite the azygous area are the shorter and of equal length, and, from these, there is a gradual lengthening to the top of the third azygous plate. All the plates are longitudinally convex and the sutures are depressed, especially at the angles, and a pore penetrates the calyx at every angle, and, on the longer sides, a pore penetrates the calyx between the angles. The greatest length of the calyx does not equal the diameter. Plates thick. Column unknown.

Basals small, wider than long, and project below the end of the column. Superior angles rather acute. Subradials the largest plates in the calyx and about as long as wide, though somewhat unequal in size, three hexagonal, two heptagonal. First radials about twice as wide as long, though of unequal length, and slightly concave the entire width above for the reception of the second radials, none of which are preserved in our specimens.

The first azygous plate is about as large as a first radial, nearly equal sided, pentagonal, rests between the superior sloping sides of two subradials, separates the first radial, on the right, from the second azygous plate, on the left, and is truncated above by the third azygous plate. The second azygous plate is nearly as large as the first, truncates a subradial, separates the first radial, on the left, from the first and third azygous plates, and thins toward the upper edge, indicating that it united with small plates belonging to a proboscis. The third azygous plate rests upon the first and in its lower part separates part of the first radial plate, on the right, from the second azygous plate and thins toward the upper edge, indicating that it united with small plates belonging to the proboscis.

This is a peculiar species and on account of its azygous area and the pores that penetrate the vault, may yet be made the type of a new genus. At least it will not be confounded with any species that has been heretofore described in this genus.

Found by R. A. Blair, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of Prof. G. C. Broadhead.

POTERIOCRINUS SAMPSONI, n. sp.

Plate IV, Fig. 9, azygous side view; Fig. 10, opposite view of same, some of the matrix is attached to the top of the first radials.

Species medium or below medium size, as indicated by two specimens, one of which is smaller than the one illustrated. Calyx like the frustum of a cone, being broadly truncated below, slowly expanding above and having a diameter about one-fourth greater than the height. Surface smooth, possibly, in better preserved specimens, granular. Plates thick and sutures close. Column large, at the superior end, as it entirely covers the truncated end of the calyx.

Basals moderate size, about a third or a half wider than high. Superior angles distinct though not acute. Subradials the largest plates in the calyx, wider than long, though unequal in size, three hexagonal, two heptagonal. First radials about twice as wide as long, though slightly unequal in size, and truncated the entire width above, for the reception of the second radials, none of which are preserved, in our specimens. The first azygous plate is smaller than a first radial, nearly equal sided, pentagonal, rests between the superior sloping sides of two subradials and separates the first radial, on the right, from the second azygous plate. The second azygous plate is much smaller than the first, truncates a subradial and separates the first one from the first radial, on the left. The third azygous plate is smaller than the second, as shown by the specimen, which is not illustrated, and beyond it, the plates are not preserved.

While this species is not distinguished by any very remarkable peculiarities, it is so different from any that have been described from rocks of the same geological age, that no comparison is necessary.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of F. A. Sampson, a distinguished naturalist of Sedalia.

ZEACRINUS BLAIRI, n. sp.

Plate IV, Fig. 5, azygous side; Fig. 6, opposite side of same specimen, showing part of the proboscis.

Species below medium size. Calyx low, basin-shaped, two and a half times as wide as high, depressed at the base, plates convex, sutures distinct, surface granular. Column small and round.

Basals form a disc one-half larger than the diameter of the column, and, in plain view, as seen from below. Subradials wider than high, and forming, with the basals, a low cup. First radials wider than long, pentagonal, truncated the entire width above, and separated from the brachials by a gaping suture. A single brachial, about as long as wide, rounded and contracted, in the middle, and axillary, supports upon its upper sloping sides, in each radial series, the free arms. The proximal arm, on the left of the azygous area, bifurcates on the sixth plate, and the proximal side again on the ninth plate, and the distal side bifurcates on the fourth plate, and the distal branch on the eighth plate, which gives to this ray six arms. The ray opposite the azygous area bifurcates, on one branch, on the fourth plate, and, on the other, on the seventh plate, which gives to it four arms. One of the lateral rays bifurcates, on each branch, on the sixth plate, which gives to it four arms. The other two rays are broken off below the first bifurcation, in our specimens; but we presume the lateral rays are alike, and the ray on the right of the azygous area the same as the one on the left, and if so, the species has twenty-four arms. The arms are short, round and composed of short plates. Pinnules small.

The azygous area is wide, ovate and exposes ten plates arranged alternately, as usual, in this genus. The first one is about half as large as a subradial, rests upon one sloping side of a subradial and abuts another, separates the first radial, on the right, from the second azygous plate and is truncated by the third plate. The second one is about the size of the first, truncates a subradial, separates the first radial, on the left, and the lower part of the brachial, from the first and third plates and is truncated above by the fourth and fifth plates. The fourth, fifth and sixth plates are in one range crossing the exposed area. The top of the proboscis is broken off in the specimen illustrated, below the top of the arms, where it is round and covered by smooth, polygonal plates.

This species is at once distinguished, by its general form and number of arms, from all others. In *Zeacrinus pocillum*, from the same rocks, there are two brachials in each of four rays, and, in the other ray, the first brachial is truncated on top and followed by five single plates, before it bifurcates; and *Zeacrinus commaticus*, from the same rocks, with its forty-six arms, is equally as far removed from this species. We know of no species with which it is necessary to compare it.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of R. A. Blair, the distinguished naturalist and collector of Sedalia, Missouri.

FAMILY CYATHOCRINIDÆ.

CYATHOCRINUS BLAIRI n. sp.

Plate IV, Fig. 11, basal view of a large specimen, azygous side up; Fig. 12, azygous side of same showing the large subradial; Fig. 13, basal view of a small specimen; Fig. 14, azygous side of the same; Fig. 15, opposite side of same.

We have three specimens of this species, though one of them is so badly crushed that it is of no service in the description. The species is rather below medium size. The calyx of the larger specimen is bowl-shaped, a little less than twice as wide as high and broadly rounded below, while the smaller specimen is more elongated and pointed below. It is possible, that the larger specimen is compressed on the under side so as to throw it a little out of its normal shape. The sutures are beveled; surface granular; column small and round.

Basals small and form a low cup, with a concave depression for the attachment of the small column, and are separated from the subradials by a beveled suture. Subradials large and gently curve from the basal cup outward and upward. The one on the azygous side is remarkably large and extends nearly as high as the first radials. First radials wider than high, sides parallel, each arcuate the entire width above for the attachment of the second plate, and having the facet directed upward or slightly inclined inward. The first azygous plate is short and extends but slightly below the level of the first radials.

This species will be distinguished by its general form, remarkably large subradial which is truncated by a short azygous plate, and by the wide arcuate facets directed upward and inward, for the attachment of the second radials. Possibly its arms, when known, will be used to distinguish it from the genus *Cyathocrinus*.

Found by R. A. Blair, in the Choutean limestone at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of the laborious and intelligent collector.

CYATHOCRINUS CHOUTEAUENSIS, n. sp.

Plate IV, Fig. 16, showing calyx and part of the arms, the azygous plate is on the right and the second and third radials in the adjoining ray are out of place, the calyx is also compressed so as to appear wider than it is.

Species medium size. Calyx obconoidal, about as high as wide, sutures close, surface granular.

Basals form a low conical cup, truncated for a small column. Superior angles obtuse. Subradials rather longer than wide, except the one truncated by the azygous plate which is wider than long, four hexagonal and one heptagonal. The heptagonal plate is the larger one. First radials about as long as wide, slightly curved over towards the vault on each side of the arm facets, and longitudinally convex and protuberant at the arm facets. Arm facets circular, occupying about half the width of the plates, and notched for the ambulacral canal. Azygous plate broadly truncates a subradial and extends above the top of the first radials.

There are only five arms. The arms are small, long and composed of long, round joints or plates. The first plate is not quite as long as wide but above this the plates are from two to four times as long as wide.

There is no described species, from rocks of the same age, with which this one can be confounded.

Found by the distinguished collector and naturalist F. A. Sampson, in the Choutean limestone at Sedalia, Missouri, and now in the collection of S. A. Miller, to whom he kindly presented it.

CYATHOCRINUS MACADAMSI, n. sp.

Plate IV, Fig. 31, azygous side on the right; Fig. 32, lateral view.

Species medium size, constricted above the calyx. Calyx short, hemispherical, twice as wide as high; plates convex; sutures distinct; surface finely granular. Column small.

Basals form a flat pentagonal disc about twice as wide as the diameter of the column. Subradials slightly wider than high and forming with the basals a low cup. First radials about one-half wider than long, pentagonal, truncated the entire width above, and separated from the second radials or brachials by a wide gaping suture. There are two brachials in each ray, the first one is quadrangular and about twice as wide as long, the second is somewhat smaller than the first, pentagonal, axillary and supports upon each upper sloping side a single arm. The body is broadly constricted in the region of the brachials, There are only ten arms and when closed they are compact, as the sides are straight and flattened. The arms are composed of wedge-shaped plates, the first ones being longer than the succeeding ones. In the three specimens examined there is some difference in the length of the arm plates and the longer ones appear to be slightly constricted, but the difference will not distinguish either specifically from the one illustrated. The first azygous plate truncates a subradial and extends a little above the top of the first radials.

The form of the calyx and the azygous plate agree with *Cyathocrinus*, but the brachials and arms remind one of *Poteriocrinus* and *Zeacrinus*. There is no described species for which this one can be mistaken.

Found by the late Hon. Wm. McAdams, in the St. Louis Group, at Alton, Illinois, and now in the collection of S. A. Miller. The specific name is in honor of the collector, who was well known as a naturalist of ability and close observation for many years.

CYATHOCRINUS BRITTSI, n. sp.

Plate IV, Fig. 35, basal view; Fig. 36, azygous side view of the calyx.

Species medium size. Calyx rather more than twice as wide as high, and somewhat obpyramidal in shape, in the superior part, though round over the subradial region. Sutures distinct, surface granular. Column large and round.

Basals form a pentagonal disc, one-third wider than the diameter of the column, which has a concave depression, though shallow, for the attachment of the column. Subradials slightly wider than high, the one on the azygous side being much larger than either of the others, though extending but little higher. First radials a little wider than high, longitudinally convex, most convex in the superior part, which gives the calyx, when seen from above, a subpentagonal outline. The upper part of these plates, too, is very thick, and the facets for the articulation of the second plates are correspondingly deep, and scarred very slightly, for the ambulacral canal. The facets are about three-fourths of the width of the plates, and have a slight transverse depression that indicates a gaping suture. The first azygous plate broadly truncates a subradial at about the middle of the first radials.

This species will be distinguished, by its general form, from all others, so that no comparison with any of them is necessary for its identification.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of Dr. J. H. Britts, one of the leading naturalists of Missouri.

FAMILY PLATYCRINIDÆ.

PLATYCRINUS TUGURIUM, n. sp.

Plate IV, Fig. 17, basal view; Fig. 18, azygous side view; Fig. 19, summit view.

This species is above medium size, and belongs rather to the discoid than to the bowl-shaped forms, and receives its specific name from a fanciful resemblance to a hut. Calyx shallow, pentagonal, two and a half times as wide as high. Plates thick, sculptured. Sutures beveled. The surface is ornamented with angular ridges and furrows as follows: An angular ridge extends from each angle of the basal disc to the columnar depression, and two or three ridges parallel with each side of the disc, are arranged between them; and, on each first radial, an angular ridge extends from each lower lateral angle, from one-half to two-thirds the length of the plate, to a constriction, or subcircular furrow, and these ridges are connected by three ridges parallel with the lower side, and there are three ridges between the subcircular furrow and each perpendicular suture.

Basals form a pentagonal disc, not higher than the thickness of the plates, with a concave depression in the central part, where the column attached; and sculptured as above described, though the sculpturing becomes less defined as it approaches the concave depression. First radials project, in the lower part, at an angle of about forty degrees; but, the superior part, beyond the constriction, is directed horizontally, and the facet, for the second plate is transverse, or nearly perpendicular, with a notch for the ambulacral canal. Surface ornamentation as above described. The angles for the reception of the interradials are more acute than is usual in this genus. There is only a single regular interradial, in each area, and it forms part of the vault.

Vault elevated and convex toward the central part, so as to have a capacity equal to or greater than the calyx. A single large spinous plate occupies the central part; it is surrounded with eight plates, six of which bear spines and the other two abut upon the azygous orifice. Each plate over the junction of the ambulacral canals bears a spine, the other plates are convex but not nodose. The azygous area is comparatively large, the first plate is as large as a regular interradial and stands nearly upright, and above on either side of it there are two small plates, and between and above these nine plates surround a large azygous orifice.

This species is readily distinguished by its general form and surface ornamentation from all heretofore described.

Found in the Burlington Group, at Sedalia, Missouri, by R. A. Blair, and now in the collection of S. A. Miller.

PLATYCRINUS FORMOSUS, n. sp.

Plate IV, Fig. 20, basal view; Fig. 21, azygous side view preserving the first azygous plate.

This species is about medium size and belongs to the discoid forms. Calyx shallow, pentagonal, four times as wide as high. Plates thick, sculptured. Sutures canaliculate. The surface is ornamented with a rounded ridge upon each side of the canaliculated sutures which bears more or less conspicuous rounded nodes. Column round.

Basals form a concave pentagonal disc, bordered by an angular nodose rim, that adjoins the canaliculated suture. The concavity is equal to the thickness of the plates and commences at the angular ridge adjoining the suture. The plates are serrated for the attachment of the column. The first radials project, at first, horizontally, and then curve upward, having a constriction in the middle part, beyound which they are directed horizontally, and the facet, for the second plate, is transverse or nearly perpendicular. Each articulating facet forms almost a circle, having a diameter more than one third the diameter of the plate, and being only slightly notched for the ambulacral canal.

The angles for the reception of the regular interradials are very obtuse, and the angle for the reception of the first azygous plate is moderately acute. The first azygous plate is pentagonal. stands upright and indicates a large area on account of its width, but it is shorter than the same plate in *P. tugurium*, and the probability is that the vault is less convex.

The calyx of this species has some resemblance in form to *P. truncatus*, but in that species, the base is flat and the surface is not ornamented, while in this species, the basal disc is quite concave and the column is inserted into the concavity and the surface is ornamented with ridges and nodes. Other differences in form, occur in the parts preserved. It cannot be mistaken for any other described species by any one capable of distinguishing specific characters.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS MISSOURIENSIS, n. sp.

Plate IV., Fig. 22, longer side view, showing the place for the attachment of the column; Fig. 23, shorter side view.

Species medium size, and the specimen upon which it is founded has longer first radials upon one side than upon the other, which forms an unsymmetrical calyx that may represent either the normal or an abnormal growth. It is also slightly compressed. Calyx somewhat bowl-shaped, broadly truncated below, outer face of the first radials flattened and sutures beveled, so that a transverse section will have a subpentagonal outline. Plates thick. Surface granular. Column round at the point of attachment, rather large and surrounded by a small projecting rim on the basals. Columnar canal large.

Basals form a pentagonal disc with a very shallow cup and have a projecting angular rim around the end of the column. The beveled and straight sutures between the basals and first radials give the basals a marked pentagonal outline. The first radials are a little larger upon one side of our specimen than upon the other, the longer ones expand most, so that each is only slightly wider than high. Each plate is flattened below the articulating facet for the second radial. Articulating facets very large, occupying from one-half to two-thirds the width of each plate and having a serrated outer edge, within which there is a straight tranverse ligamental furrow. Wide notch for the ambulacral canal.

This species is distinguished by its bowl shape and pentagonal outline, and remarkable articulating facets for the second radials.

Collected by R. S. Blair in the Chouteau limestone near Sedalia, Missouri, and presented by him to S. A. Miller.

PLATYCRINUS PETTISENSIS, n. sp.

Plate IV, Fig. 24, basal view; Fig. 25, side view of same specimen.

Species medium sized. Calyx bowl-shaped, truncated for the attachment of the column and projecting at the arm bases, so as to give it a pentagonal outline above. Surface smooth in the four specimens examined, and sutures slightly beveled. Column medium size.

Basals form a cup about twice as wide as high, pentagonal at the top, and truncated for the column. First radials wider

than high, gradually expanding, convex longitudinally and projecting at the articulating scales. Articulating facets rather large, directed upward, at an angle of about sixty degrees, form more than a semicircle, occupy about half the width of a plate and are notched in the central part for the ambulacral canal.

This species is founded upon four specimens the larger one of which is illustrated. It resembles *P. annosus* more than any other described species, but will be distinguished from it, by the higher cup formed by the basal plates, larger truncation for the column, and more prominent and larger articulating facets for the second radial. We have examined fifteen specimens of *P. annosus*, and the above differences are constant, and the species need not be confounded even on a superficial examination.

Collected by R. A. Blair, in the Chouteau limestone, in Pettis county, Missouri, near Sedalia, and by him presented to S. A. Miller.

PLATYCRINUS CLINATUS, n. sp.

Plate IV, Fig. 26, shorter side of a large specimen; Fig. 27, longer side of same; Fig. 28, longer side of another specimen, showing an interradial on the azygous side; Fig. 29, shorter side of same; Fig. 30, longer side of a smaller specimen.

We have examined ten specimens belonging to this species, ranging in size between the largest and smallest specimens illustrated, and we believe the specimen illustrated by figure 4, plate I, Bulletin No. 4, Geo. Sur. Mo., belongs to this species, though it is not at hand for re-examination. All of the specimens are larger on one side than on the other, and the first radials are longer on one side than on the other, proving that this is the normal condition of the species. The larger side is the azygous side and opposite to the small basal. The basal plates are generally anchylosed, but in the specimens illustrated we have been able to see the sutures.

Species below medium size. Calyx with a large truncated base, above which it is abruptly constricted and then gradually expands to the top of the basals, and, from there, expands more rapidly to the facets for the second radials, which gives it a pentagonal outline on top. Sutures between the radials and between the basals and radials beveled. Surface granular. Plates thick. Column round and large.

Basals form a short subcylindrical cup, with an expanded base. First radials of unequal size, differing as much in width as in length, and subquadrate in outline; they are longitudinally convex in the central part, projecting most at the articulating facets for the second radials, and depressed at the longitudinal sutures. Articulating facets large, occupying about two-thirds the width of each plate, and sloping downward so as to be directed at an angle of sixty degrees, from a perpendicular line. The azygous interradial is large and stands nearly upright. The angles for the reception of the regular interradials are very obtuse.

This species will be readily distinguished, by its general form and thick plates, from all others. It bears most resemblance to *Platycrinus allophylus*.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS SULCIFERUS, n. sp.

Plate IV, Fig. 33, basal view; Fig. 34, side view.

Species above medium size and belongs to the discoid forms. Calyx shallow, pentagonal, two and a half times as wide as high. Plates thick, furrowed. Sutures broadly beveled.

Basal disc large, pentagonal, concave in the central part and having a furrow just within the pentagonal border. First radials wider than high, project at an angle of about forty-five degrees, sharply constricted below the facets for the second radials. The facets are semi-elliptical, directed horizontally, and broadly notched for the ambulacral canal. There is a furrow just within the beveled edge adjoining the basal disc, and one on each side of each plate adjoining the beveled suture. The angles for the reception of the regular interradials are obtuse The valt and arms are unknown.

This species is distinguished from other discoid species having beveled sutures, by the furrow within the border of each plate, without other ornamentation by the sharp angular constriction below the articulating facet, and by the semi-elliptical facet. These surface characters readily distinguish it from other species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS CASULA, n. sp.

Plate IV, Fig. 37, basal view; Fig. 38, azygous side on the right; Fig. 39, view opposite the azygous side; Fig. 40, summit view.

Species medium size and belongs to the bowl-shaped forms. Calyx bowl-shaped, pentagonal, rather more than one and a half times as wide as high. Plates thick. Sutures broadly beveled. Surface without ornamentation. Column round at the calyx.

Basal disc pentagonal, nearly three times as wide as the diameter of the column and having a height about equal to the thickness of a plate. It is concave below for the column attachment, and bordered by an angular pentagon from which it is beveled to the suture above. First radials a little wider than high, slowly expand to form the cup and become convex toward the facets, for the second radials. The facets are semi-elliptical, directed at an angle of forty-five degrees, and occupy about half the width of the plates. The second radials are very short and axillary. The ambulacral notch is small in both the first and second radials. The angles for the reception of the interradials, which are in fact plates of the vault, are quite obtuse.

The vault is only slightly convex and is covered with a few rather large convex plates. Five large plates occupy the central part and these are surrounded by a single row of plates consisting of the interradials and those covering the ambulacral canals and those forming the proboscis on the azygous side. The proboscis is large and consists of numerous small plates, and the first azygous interradial, which is large, stands upright and forms part of it.

The species is distinguished by its pentagonal, bowl-shape, absence of ornamentation and peculiar vault and proboscis.

Found by R. A. Blair in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS SEMIFUSUS, n. sp.

Plate IV, Fig. 41, side view; Fig. 42, basal view.

This species is founded upon two casts, but the specimens are in a fine state of preservation, and the ornamentation, we presume, indicates the ornamentation of the test. The species is above medium size. The calyx is pointed below, subpentagonal from the basals upward and constricted below and at the second radials, so as to destroy the subpentagonal outline. The heigth is a little more than the diameter and if the test were preserved the heigth would still be more than the diameter. The shape is half fusiform. The surface is ornamented with rounded ridges that radiate downward from the second radials to the base of the first radials and then contract to the pointed base below, and these ridges bear very fine longitudinal lines; or we might say the specimens are ornamented with longitudinal, low, fusiform ridges, that are longitudinally marked with very fine lines.

Basals form a cup, pentagonal above and pointed below, and having a diameter equal to about two and a half times the height. The first radials have a length greater than the width and have nearly parallel sides. The facets for the articulation of the second radials are very small. The vault is unknown.

The general form will distinguish this species from all others, beside, the surface ornamentation is quite peculiar.

Found by R. A. Blair in the chert belonging to the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS MODESTUS, n. sp.

Plate IV, Fig. 43, side view; Fig. 44, basal view; Fig. 45, Summit view, of the same specimen.

We have several specimens of this species, but they are all casts. The species is below medium size. The calyx is bowl-shaped, pentagonal, and about one-third wider than high. It is constricted below the arms. There are no indications of any ornamentation.

Basals form a nearly flat, pentagonal disc. The first radials have a width a little greater than the length and they expand moderately upward. The superior angles are strongly truncated for the reception of the interradials. The facets for the articulation of the second radials are not preserved, but the ambulacral canals make a delicate notch in the middle of each first radial.

The vault is elevated and convex, the first interradials are large and stand nearly upright, but curve the superior end slightly over on the vault. The ambulacral canals are remarkably deep and form elevated rounded ridges on the summit of the vault; in other words, they cut the first radials and form the highest part of the vault. The vault is covered with polygonal plates, the central one being about as large as an interradial. The proboscis is sub-central.

While there are some pentagonal, bowl-shaped species that the calyx of this species resembles, there are none described having any such vault as this one has.

Found in the chert belonging to the Burlington Group at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS GERMANUS, n. sp.

Plate IV, Fig. 46, side view, the spines may be foreign matter; Fig. 47, basal view, one plate is pushed a little out of place, and the spines on one belong to foreign material.

Species medium size. Calyx somewhat obpyramidal, rather rapidly expanding especially toward the arm bases, which gives to the upper part a pentagonal outline; truncated below, only to the extent of the diameter of the column; diameter about one-half more than the height; surface granular.

Basals form a cup two and a half times the diameter of the column, the lower part having a concave depression for the attachment of this column without any surrounding rim. The facets supporting the radials are slightly concave. First radials a little longer than wide, gradually expanding, convex longitudinally, depressed towards the sutures, and most tumid toward the second radials. Articulating facets directed upward at an angle of about forty-five degrees, form more than half a circle, and occupy about half the diameter of each plate. Only slightly notched in the central part. Second radials short and axillary.

Vault elevated, the first interradials standing nearly upright. There are a few large spines on the summit of the specimen, but as the outlines of the plates cannot be determined it is not certain that the spines belong to it, probably they belong to foreign matter.

This species is distinguished from *P. æquiternus*, which it most resembles, by the form of the basals as well as by the proportion of the height to the diameter. The facets for the second radials are also somewhat different, and the angles for the interradials are more obtuse in that species than in this, which shows that the vaults are different, though unknown beyond those plates. It might also be compared with *P. pettisensis*, from which it may be distinguished by the form of the basal cup and the articulating facets for the second radials, and by minor details.

Found by Mr. F. A. Sampson in the Chouteau Group, at Sedalia, Missouri, and now in his collection.

FAMILY PISOCRINIDÆ.

PISOCRINUS BACCULA, n. sp.

Plate V, Fig. 23, side view showing the small single radial; Fig. 24, side view showing the large radial; Fig. 25, basal view; Fig. 26, summit view of calyx.

Species large, quite as large as *P. campana*. Calyx somewhat bell-shaped or like a huckleberry; greatest diameter at the lower third and below the point of the small radial; abruptly rounded below and deeply concave or sunken at the columnar pit; rapidly contracted in the upper part. The specimen illustrated is not round, as seen from below, and all three of the specimens examined seem to be somewhat irregular in this respect, though each of the others is more nearly round and regular than the one illustrated. Plates thick. Surface smooth.

The five basals form almost an equilateral triangle that is not visible in a side view except at the angle below the small radial. They are abruptly bent down into the columnar cavity. The three plates in the angles are quadrilateral, the other two are triangular. There is not much difference in the size of the basals. The positions of the subradial and the five radials are the same as in *P. gemmiformis*, the difference in size and form simply gives the difference in the shape of the calyx which is much more contracted in the superior part of this species than in that one. The form of this species is such that the arm blades must be shorter than in other species, and smaller in proportion to the size of the body, or they must spread above the mortises or articulating facets, differently from other species.

Found in the Niagara Group, near St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

PISOCRINUS MILLIGANI, n. sp.

Plate V, Fig. 27, side view of a complete specimen which also preserves part of the column magnified two diameters; Fig. 28, basal view of the same specimen magnified two diameters. This specimen does not show the sutures in the calyx. Figs. 21, 22 and 23, on Plate VI of the 17th Report of the Geological Survey of Indiana belong to this Species.

Species medium size, larger than *P. gorbyi*, which it resembles. Calyx obpyramidal, truncated below and has a deep columnar pit, and more or less rapidly expands in the radial regions, giving to the upper part a pentalobate aspect. There is some difference among the specimens as to the proportions in length and breadth and as to the extent of the pentalobate extensions; but the specimens illustrated here and in the Indiana report are average in this respect. *P. gorbyi* is longer in proportion to the diameter than this species. Plates thick; surface smooth. Column small and round.

The five basal plates form a triangle that occupies the basal cavity and the lower part of the calyx so as to be seen in a side view even plainer than they can be in *P. gorbyi*. The subradial and radial plates are proportionally shorter and wider than in *P. gorbyi* and the lobate character more pronounced. The radials are excavated by a wide dove-tailed mortise on the lobes of the calyx, and, in the depressions between the lobes, curve in over the calyx so as to leave the summit, when the arm blades are removed, with a five-rayed star-like opening. There is no vault plate. The tenons of the blades fill the mortises, and the blades unite, leaving only a small round opening at the center, which is continued up between the blades, but it is much contracted at the summit. Each arm blade consists of a single plate. The specimen illustrated is complete.

The arm blades are larger and stronger in this species than in *P. gorbyi*, which is a marked distinction, though the shorter and wider radials will enable any one to distinguish the species, in the absence of the arm blades.

There are, in the collection of Mrs. J. M. Milligan, five specimens of this species having the arm blades, and many specimens, in which the arm blades are not preserved; there are also specimens, without the arm blades, in the collection of the authors, all of which came from Decatur county, Tennessee. It must be apparent to any one having been a student of the Echinodermata that *Pisocrinus* is not more nearly related to the order *Palæocrinoidea* than it is to the *Blastoidea*. It has neither the arms nor the vault of a crinoid, besides being anomalous, in the arrangement of the plates of the calyx.

Found by Mrs. J. M. Milligan, in the Niagara Group, of Decatur county, Tennessee. The specific name is intended as a compliment to the lady who collected the fossils from that locality and has been a student of Natural History for many years.

THALAMOCRINIDÆ, n. fam.

This family name is proposed to receive the new genus Thalamocrinus and for the present, the family characters must be regarded the same as the generic.

THALAMOCRINUS, n. gen.

[Ety, *thalamos* a small house or den; *krinon* lily.]

Body pear-shaped or more or less fusi form, and covered by three ranges of plates and a small vault. Basals or first circle plates five, equal. Subradials or second circle of plates five. Radials or third circle of plates six. The vault is unknown but supposed to be like the vault of *Zophocrinus*. Column small. No arms. Type *T. ovatus*.

This genus is only referred to the Palaeocrinoidea provisionally. Probably a new order should be established to include it and *Zophocrinus* and some other forms that are not very well understood.

THALAMOCRINUS OVATUS, n. sp.

Plate V, Fig. 29, side view; Fig. 30, azygous side; Fig. 31, summit view without the vault, magnified two diameters.

Body small, oval or pear-shaped, greatest diameter at the upper third; length one third more than the diameter; surface smooth.

The five basal plates are of equal size and about one third the length of the body. They are excavated below apparently for the attachment of a column, but the columnar canal is too minute to be seen except with a strong magnifier and even then it looks like a very minute, round orifice. The second series of plates are subradial in position and alternate with the basals. They constitute a little more than half the length of the body; four of them are hexagonal and one is heptagonal. The plates in the third range are short and five of them alternate with the subradials, while one of them truncates the heptagonal plate at the top, on the azygous side. The short plates forming this circle are beveled toward the interior at the top, and present an appearance much like *Zophocrinus*, when the vault is removed in that genus, which indicates a similarity in the vaults of the two genera.

Found by Mrs. J. M. Milligan, in the Niagara Group, in Decatur county, Tennessee, and now in her collection. There are three specimens, one is smaller than the specimen illustrated, and another is more than twice as large, so that the natural size of it is as large as the illustrations.

THALAMOCRINUS CYLINDRICUS, n. sp.

Plate V, Fig. 32, side view of two ranges of plates; Fig. 33, summit view of second range, magnified two diameters.

Body small, subcylindrical or somewhat fusiform. Length more than twice the diameter. Surface smooth. Sutures very distinct and slightly beveled.

Basals of equal size and having a length equal to the diameter of the cup. Truncated below, and under an ordinary magnifier no columnar canal is visible, though there is a cicatrix for some kind of attachment. The second circle of plates alternate with the basals and form a small cylinder having a length fully equal to the diameter. The thick plates may be seen at the end and the small, round visceral cavity. The third circle or radial plates are destroyed in our specimen, but the facets for attachment are preserved and there is no reasonable doubt but that there are six of them.

Found by Mrs. J. M. Milligan, in the Niagara Group, in Decatur county, Tennessee, and now in her collection.

FAMILY UNCERTAIN.

INDIANOCRINUS, n. gen.

[Ety. proper name, *Indiana*; *Krimon*, lily.]

This genus is founded upon the calyx of a single specimen and hence there are only a few characters to be ascribed to it. Basals, five. No subradials. Primary radials one by four Arms four. No regular interradials. Azygous interradial rests between the upper sloping sides of two basals and is followed by two plates at the top of the calyx. Plates punctate. Type *I. punctatus*. This genus cannot be certainly classed in any family.

INDIANOCRINUS PUNCTATUS, n. sp.

Plate V, Fig. 8, basal view; Fig. 9, summit view; Fig. 10, lateral view, azygous side on the right; Figs. 11, 12 and 13, same views magnified two diameters.

Calyx pear-shaped; plates longitudinally convex; sutures depressed. Surface pitted or punctate. Column very small.

Basals pentagonal, elongated, truncated for a very small column and forming together a pentagonal cup, with depressed longitudinal sutures, about one-third of the height of the calyx. Primary radials longer than wide, the two adjoining the azygous area larger than the other two, most convex in the middle, at the lower edge of the articulating facets; lateral sutures deeply depressed toward the top of the calyx. Facets for the second radials a little more than one-third of the width of the plates, subelliptical in outline and deeply notched for the ambulacral canals. The angles formed, at the sutures on the superior face, between the articulating facets, are obtuse, as the superior lateral angles of the first radials curve over toward the vault.

The first azygous plate is hexagonal, as wide as long, very tumid or bulged out in the central part, rests between the upper sloping sides of two basals, separates two first radials and is followed by two plates that are not preserved in our specimen. The two superior faces are concave. The vault is unknown.

This species is extraordinary because there are only four arms; because the first azygous plate rests between the upper sloping sides of two basals, and because the plates are pitted. The specimen is well preserved and in its normal condition. The hole shown in the illustrations does not appear to pass through the test and may not properly belong to the species as a character of any importance.

Found in the Niagara Group, at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

ORDER CYSTOIDEA.

FAMILY HOLOCYSTIDÆ.

HOLOCYSTITES ASPER, n. sp.

Plate V, Fig. 1, *summit view; Fig. 2, anterior side view.*

Body medium size, subovate most tumid on the left anterior side, plates large, convex, covered with large pastules and pierced with numerous pores; sutures deeply impressed. The specimen illustrated has the lower part broken away, so whether or not it was sessile cannot be determined, and probably two ranges of plates are gone; five ranges of plates only are preserved.

The first range of plates preserved, which is, in fact, the second or third range, consists of four large plates and four smaller ones, the latter are on the anterior side and may be seen at the bottom of figure 2. The second range has eleven plates, of unequal size; the third range has eleven plates, the fourth range six, and the fifth range, that surrounds the ambulacral orfice, at the center of the summit, has six plates. There are no intercalated plates between the ranges in our specimen.

The mouth is surrounded by five plates and is submarginal between the range that surrounds the ambulacral orifice and the next range below. Four of the plates that scrround the ambulacral orfice have spine bases.

This specimen will be distinguished by its general rough form, flattened or depressed anterior side, ventricose upper part of the left anterior side, increased size and irregular outline of plates to cover the ventricose parts of the body without its intercalation of small plates between the ranges, by the number of plates in the ranges, and by the four spine-bearing summit plates. If two ranges of plates are broken off from the lower part then it is, probably, nearer to *H. ornatissimus*, than to any other species, agreeing with it in the number of ranges of plates and summit spines, but differing in the shape of the body, the position of the greater tumidity, and in the number of plates in each of the ranges below the summit.

Found in the lower part of the Niagara Group near Madison, Indiana, and now in the collection of J. F. Hammell.

HOLOCYSTITES SPHAEROIDALIS, n. sp.

Plate V, Fig. 3, summit view; Fig. 4, left side view.

Species sessile, with a large subelliptical base of attachment, that is very short. Body medium or below medium size, subspheroidal, though bulging on different parts, most tumid in the left posterior part, where it is peculiarly prolonged Plates small in the lower part, but medium size above, very slightly convex in part and plane in part, and pierced with numerous pores without any order of arrangement. Sutures not beveled and traced with some difficulty.

The first range of plates above the solid base of attachment is composed of very short, wide plates that are interrupted in the posterior part, so as not to make a complete circle. The second range is composed of small plates that are longer than wide on the front and sides, but wider on the posterior part, and form a complete circle. The third range is similar to the second, but the plates are longer. In the fourth range there are twenty-seven plates, differing somewhat in size, but all of them rather larger than wide. In the seventh range sixteen plates, four of which abut upon the oral opening or mouth, as shown in figure 3, and there is a small triangular plate that abuts upon the mouth and cuts off an angle from two of these plates. The eighth range surrounds the ambulacral orifice and consists of eight plates, five of which bear the scars of ambulacral spines, and one is inserted between the mouth and the ambulacral orifice. The mouth is submarginal, large and somewhat smaller than the very large ambulacral orifice, each is surrounded by eight plates.

This species will be distinguished by its general form, great number of plates, none of which are intercalated, except the triangular one that abuts upon the mouth, eight ranges, five spine bases, and sessile habit.

Found in the lower part of the Niagara Group near Madison, Indiana, and now in the collection of Mr. J. F. Hammell.

ORDER BLASTOIDEA.

FAMILY CODASTERIDÆ.

CODASTER BLAIRI, n. sp.

Plate V, Fig. 20, basal view; Fig. 21, side view; Fig. 22, summit view, one triangular field is covered with part of the matrix so that the azygous opening cannot be seen.

Calyx obpyramidal, summit convex, so that the total length, from column to summit, is equal to the greatest diameter. Transverse section of the calyx pentagonal with slightly concave sides; surface marked with numerous fine lines parallel to the sutures between the plates, except the three longitudinal sutures between the basals. Truncated at the base for a very small, round column.

There are three basals, the two larger ones are of equal size and pentagonal, the smaller one is tetragonal and each has its inner apex notched to form part of the round columnar canal. The basals form a pentagonal cup about half the height of the calyx. Radials a little wider than high, equal, truncated above, and mesial gibbosity gives the pentagonal outline to the summit. From a central, pentagonal, stelliform opening, five triangular fields radiate to the angles of the pentagonal summit. The one which is smooth and bears the anal opening, in other species, has part of the matrix attached to it in our specimen, so the anal orifice cannot be distinguished. Each of the other four triangular fields is divided by a narrow angular radiating ridge that terminates at the lateral suture between the first radials called the "oral ridges." The pseudoambulacra are narrow and each one shows a dividing line or furrow from the central oral opening half way to the angles of the pentagon. There are eight hydrospire slits in each of the eight areas between the oral ridges and the pseudoambulacra.

The general form and eight hydrospire slits in each field will distinguish this species.

Found by R. A. Blair, in whose honor the specific name is proposed, in the Chouteau limestone near Sedalia, Missouri, and now in the collection of S. A. Miller.

SUBKINGDOM CŒLENTERATA.

CLASS ANTHOZOA.

SUBCLASS ZOANTHARIA.

FAMILY ZAPHRENTIDÆ.

HADROPHYLLUM TENNESSEENSE, n. sp.

Plate V, Fig. 16, summit view of a slightly convex specimen; Fig. 18, summit view of a more convex specimeu; Fig. 17, lateral view of same; Fig 19, basal view.

Corallum medium size, short, longitudinally double convex, transversely elliptical. Calyx convex, sometimes very highly convex and having a flattened or slightly concave central area, the greater convexity is opposite the septal fossette and above the place of attachment or commencement of growth. A thickened septa occupies the center of the septal fossette running with the longer diameter of the calyx from the central part to the border; the septal fossette extends around the central end of the thickened septa and its sides, from which the lateral septa radiate to the border. The lateral fossettes are inconspicuous, but are indicated by a depression from the center to the lateral borders. The radiating septa are unequally developed, those upon the sides of the septal fossette are much shorter than the others. There are from twenty-two to twenty-six in the specimens examined. The point of attachment or place of commencement of growth is subcentral or below one of the foci of the ellipse formed by the calicular border. From a short elliptical base the corallum is abruptly expanded to the calicular border.

The length of a specimen is about three-tenths of an inch; shorter diameter of the calyx about four-tenths of an inch, and longer diameter of the calyx about six-tenths of an inch. Our specimens are silicified and do not show any epitheca, dissepiments, tabulæ or columella.

Found in the Silicified Subcarboniferous beds of Lincoln county, Tennessee, which we suppose are of the age of the Keokuk Group, and now in the collection of Wm. F. E. Gurley.

CLASS, CEPHALOPODA.

ORDER, NAUTILOIDEA.

FAMILY CYRTOCERATIDÆ.

CYRTOCERAS KANSASENSE, n. sp.

Plate V, Fig. 5, ventral view; Fig. 6, lateral view; Fig. 7, position of the siphuncle and convexity of the septa at the fifth air chamber that is preserved, in the specimen illustrated.

Our specimen is not complete and shows the siphuncle and convexity of the septa at the small end; and has been broken at the fifth septa, so that it may be examined in two places, and figure 7 is taken from a view at the fifth septa.

The shell rapidly expands, is gently curved, and slightly depressed from a true circle, in tranverse section, on the ventral side. The outer shell is preserved forward of the fifth septa, so that only five air chambers can be seen, but the end of the siphuncle indicates there are air chambers forward of that point. The siphuncle is small and near the vental side, the expansion within the air chambers is not disclosed. The convexity of the septa is rather more than the length of an air chamber. The septa are distant about one-fifth the diameter of the shell. The outer shell is transversely furrowed. On the ventral side the spaces between the furrows are flattened and wider than the furrows. On the dorsal side the furrows and ridges are subequal. The body chamber is not completely preserved, and the aperture, therefore, is unknown.

This species is quite distinct from all others in almost every respect and may not belong to *Cyrtoceras*. When compared with *C. dilatatum*, it will be noticed that the surface is furrowed instead of imbricated and the septa are not half as numerous. It is not necessary to draw comparisons with other species.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

SUBKINGDOM ARTICULATA.

CLASS ANNELIDA.

ORDER TUBICOLA.

FAMILY SERPULIDÆ.

SPIRORBIS BLAIRI, n. sp.

Pplate V, Fig. 15, a coil attatched to Platystoma broadheadi; Fig. 14, an old specimen with the anterior end prolonged upward.

Shell sinistral and in its young state attached throughout its length. Umbilicus wide. Surface marked with unequally distant rings of growth. In an old specimen, as shown by Figure 14, the anterior end is prolonged and stands upright. The lower side of the shell, that attached to some foreign object is flattened, otherwise a transverse section is circular. The aperture seems, in all stages of growth, to have been directed upward and when a complete coil, for attachment, had been formed the further growth was in the form of a loose spiral or upright tube.

Five specimens belonging to this species have been examined and the growth of the spiral in all cases, was to the left as sinistral. About one coil and a quarter or less than one turn and a half attached to the foreign substance. The transverse ridges are closer and finer on some specimens than upon others, but always more or less irregular, and sometimes quite coarse and wavy, indicating lines of growth, rather than surface ornamentation.

This species is distinguished by its sinistral growth, freedom towards the aparture, and surface lines of growth.

Found in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of R. A. Blair, the original collector.

PLATE I.

Page.

Batocrinus polydactylus, n. sp. 5
Fig. 1. View showing calyx, arms and part of column.

Batocrinus sampsoni, n. sp. 7
Fig. 2. View of calyx and arms.
Fig. 3. Lateral view of another specimen.

Batocrinus veterator, n. sp. 8
Fig. 4. View showing calyx and arms.

Batocrinus vetustus, n. sp. 10
Fig. 5. Azygous side view.
Fig. 6. View opposite azygous side.

Batocrinus venustulus, n. sp. 12
Fig. 7. Azygous side view of a specimen showing calyx and arms.

Batocrinus insuetus, n. sp. 14
Fig. 8. Azygous view.
Fig. 9. Calyz, proboscis and arms of same.

Batocrinus broadheadi, n. sp. 15
Fig. 10. Basal view of a calyx.
Fig. 11. Lateral view of the same.

Batocrinus nitidulus, n. sp. 17
Fig. 12. Azygous side view of a calyx.
Fig. 13. Opposite side of same.

Batocrinus peculiaris, n. sp. 18
Fig. 14. Azygous side view of a calyx.
Fig. 15. Basal view of the same.
Fig. 16. Summit view of the same.

Batocrinus imparilis, n. sp. 20
Fig. 17. Azygous view of a calyx.
Fig. 18. Opposite view of the same.

Batocrinus incultus, n. sp. 21
Fig. 19. Azygous view.
Fig. 20. Opposite view.

Batocrinus insperatus, n. sp. 22
Fig. 21. Azygous view.
Fig. 22. Opposite view.

Batocrinus formaceus, n. sp. 24
Fig. 23. Azygous view.
Fig. 24. Opposite view.

Batocrinus inconsuetus, n. sp. 25
Fig. 25. Basal view.
Fig. 26. Lateral view.
Fig. 27. Summit view.

Batocrinus serratus, n. sp. 27
Fig. 28. Basal view.
Fig. 29. Lateral view.
Fig. 30. Summit view.

Batocrinus ignotus, n. sp. 28
Fig. 31. Basal view.
Fig. 32. Lateral view.
Fig. 33. Summit view.

Batocrinus modestus, n. sp. 30
Fig. 34. Basal view.
Fig. 35. Lateral view.
Fig. 36. Summit view.

Batocrinus heteroclitus, n. sp. 31
Fig. 37. Basal view.
Fig. 38. Lateral view.
Fig. 39. Summit view.

Batocrinus procerus, n. sp. 33
Fig. 40. Basal view.
Fig. 41. Lateral view.
Fig. 42. Summit view.

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 7.

Plate I.

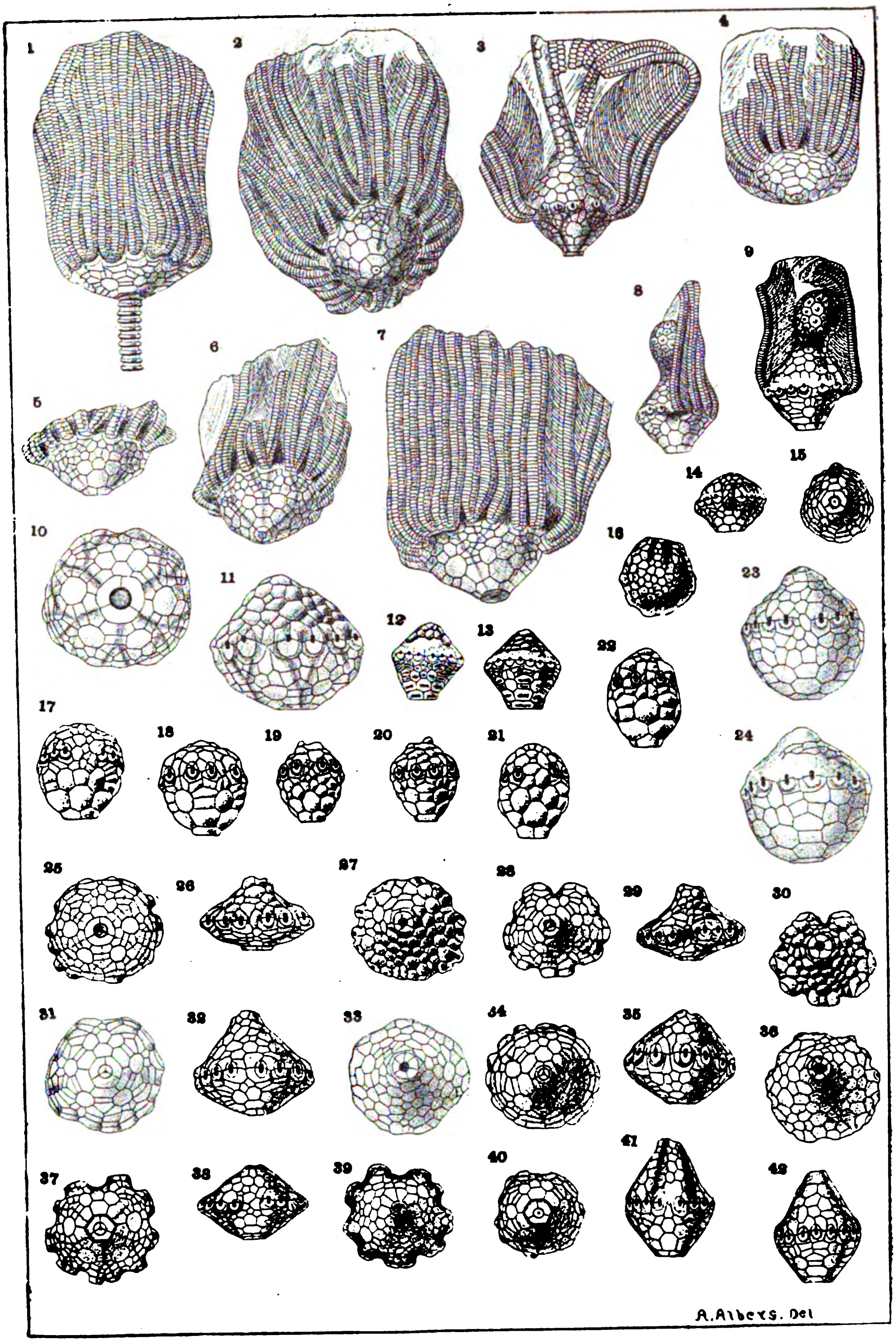

PLATE II.

PAGE.

BATOCRINUS VICINUS, n. sp. 34
Fig. 1. Basal view.
Fig. 2. Lateral view.
Fig. 3. Summit view.

BATOCRINUS INOPINATUS, n. sp. 36
Fig. 4. Basal view.
Fig. 5. Lateral view.
Fig. 6. Summit view.

BATOCRINUS PLANUS, n. sp 37
Fig. 11. Basal view.
Fig. 12. Summit view.
Fig. 13. Lateral view.
Fig. 14. Basal view of another specimen.

SHUMARDOCRINUS CONCINNUS, n. sp. 41
Fig. 7. Basal view.
Fig. 8. Summit view.
Fig. 9. Lateral view.
Fig. 10. Azygous side view.

MEGISTOCRINUS ORNATUS, n. sp. 42
Fig. 15. Basal view, azygous side up.
Fig. 16. Azygous side view.
Fig. 17. Summit view.

MEGISTOCRINUS HEMISPHERICUS, n. sp. 44
Fig. 18. Basal view, azygous side up.
Fig. 19. Azygous side view.
Fig. 20. Summit view.

ACTINOCRINUS ALBERSI, n. sp 46
Fig. 21. Azygous side view.
Fig. 22. Opposite side of same.
Fig. 23. Summit view.

ACTINOCRINUS FOVEATUS, n. sp. 49
Fig. 25. Azygous side view.
Fig. 26. Opposite side of another specimen.

STROTOCRINUS BLAIRI, n. sp. 48
Fig. 24. Lateral view of a calyx.

MELOCRINUS SAMPSONI, n. sp. 55
Fig. 27. Basal view.
Fig. 28. Azygous side view.
Fig. 29. Opposite side of same.

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Bulletin No. 7. **Plate II.**

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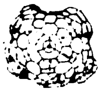
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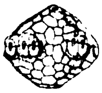
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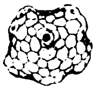
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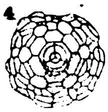
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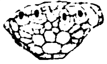
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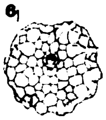
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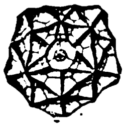
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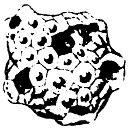
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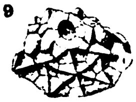
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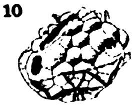
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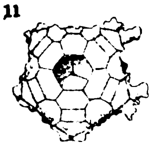
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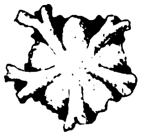
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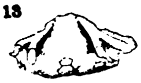
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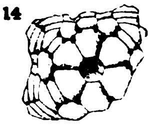
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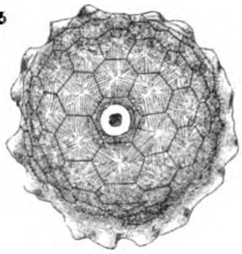
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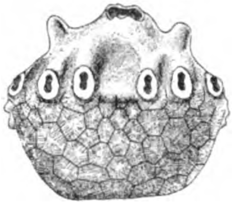
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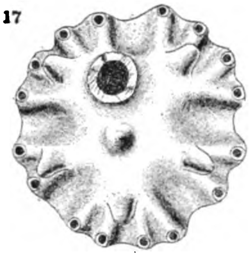
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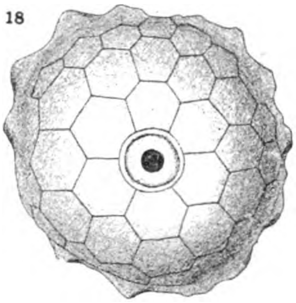
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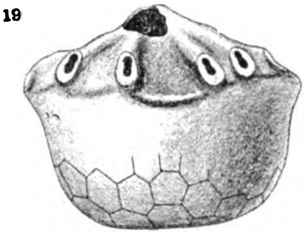
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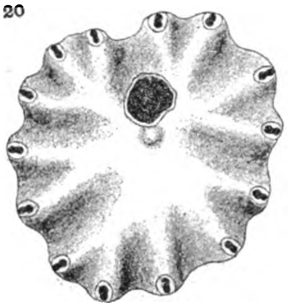
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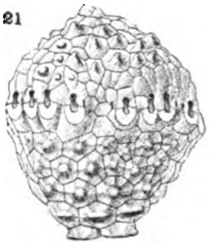
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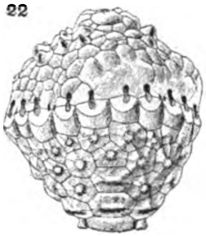
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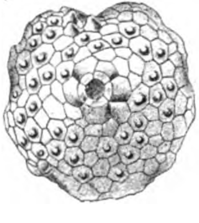
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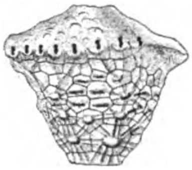
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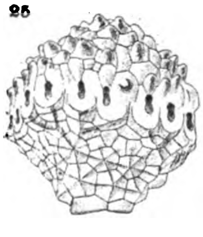
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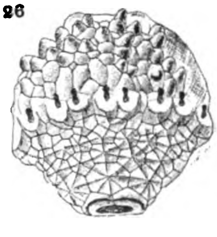
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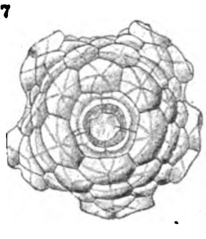
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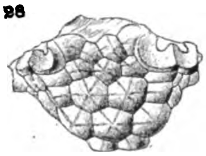
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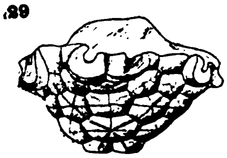

A. Albers. Del.

PLATE III.

PAGE.

BATOCRINUS PRODIGIALIS, n. sp 39
Fig. 4. Basal view.
Fig. 5. Axygous side view.
Fig. 6. Summit view.

SAMPSONOCRINUS HEMISPHERICUS, n. sp 56
Fig. 7. Basal view.
Fig. 8. Summit view.
Fig. 9. Axygous side view.
Fig. 10. Lateral view.

DOLATOCRINUS NODOSUS, n sp 56
Fig. 1. Basal view.
Fig. 2. Azygous side view.
Fig. 3, Summit view.

DOLATUCRINUS SACCULUS, n. sp 58
Fig. 11. Basal view.
Fig. 12. Azygous side view.

DOLATOCRINUS SALEBROSUS, n. sp 59
Fig. 13. Basal view.
Fig. 14. Lateral view.
Fig. 15. Summit view.

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Bulletin No. 7. Plate III.

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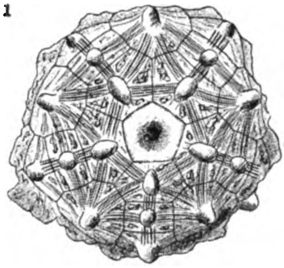

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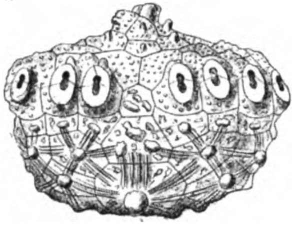

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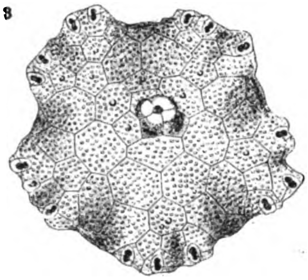

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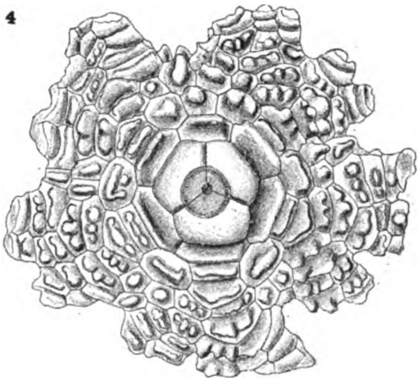

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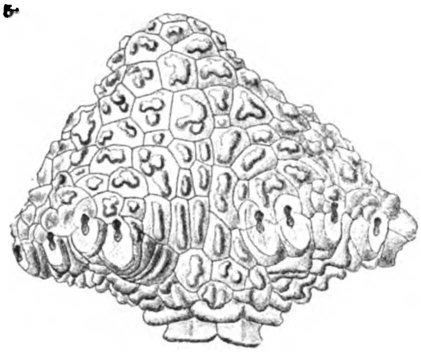

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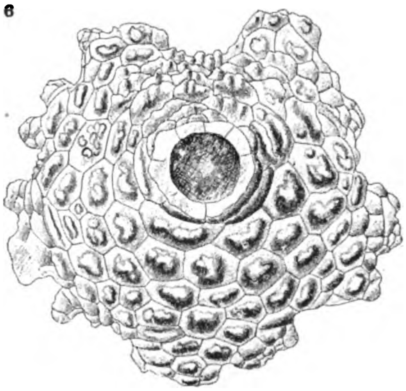

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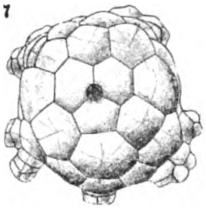

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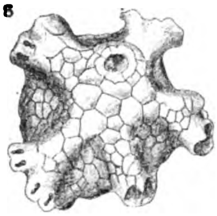

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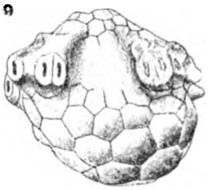

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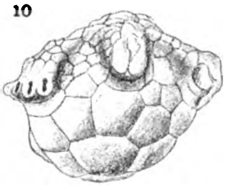

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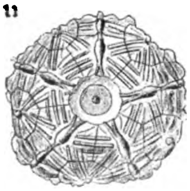

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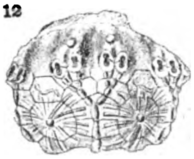

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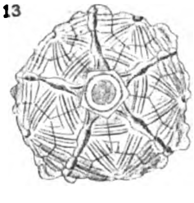

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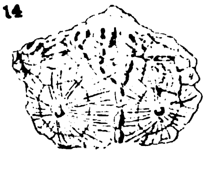

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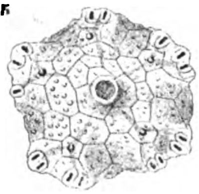

A. Albers Del

PLATE IV.

PAGE

Poteriocrinus blairi, n. sp 61
Fig. 1. Azygous side view.
Fig. 2. Opposite side view.

Poteriocrinus altonensis, n. sp 62
Fig. 3. Calyx and arms; azygous side on the right.
Fig. 4. Opposite side of same.

Poteriocrinus broadheadi, n. sp 63
Fig. 7. Azygous side view of calyx.
Fig. 8. Opposite side of same.

Poteriocrinus sampsoni, n. sp 65
Fig. 9. Azygous side view of calyx.
Fig. 10. Opposite side of same.

Zeacrinus blairi, n. sp 66
Fig. 5. View of azygous side.
Fig. 6. Opposite view of same.

Cyathocrinus blairi, n. sp 67
Fig. 11. Basal view, azygous side up.
Fig. 12. Azygous side view.
Fig. 13. Basal view of another specimen.
Fig. 14. Azygous side view of the same.
Fig. 15. Lateral view of same.

Cyathocrinus chouteauensis, n. sp 68
Fig. 16. View of a calyx and part of arms, azygous side on the right.

Cyathocrinus macadamsi, n. sp 69
Fig. 31. Calyx and part of arms, azygous side on the right.
Fig. 32. Lateral view of the same.

Cyathocrinus brittsi, n. sp 70
Fig. 35. Basal view of calyx.
Fig. 36. Azygous side of same.

Platycrinus tugurium, n. sp 70
Fig. 17. Basal view.
Fig. 18. Azygous side view.
Fig. 19. Summit view.

Platycrinus formosus, n. sp 72
Fig. 20. Basal view.
Fig. 21. Azygous-side view.

Platycrinus missouriensis, n. sp 73
Fig. 22. View of longer side.
Fig. 23. View of shorter side.

Platycrinus pettisensis, n. sp 73
Fig. 24. Basal view.
Fig. 25. Lateral view.

Platycrinus clinatus, n. sp 74
Fig. 26. Shorter side view.
Fig. 27. Longer side view.
Fig. 28. Longer side of another specimen.
Fig. 29. Shorter side of same.
Fig. 30. Longer side of another specimen.

Platycrinus sulciferus, n. sp 75
Fig. 33. Basal view.
Fig. 34. Lateral view.

Platycrinus casula, n. sp 76
Fig. 37. Basal view.
Fig. 38. Azygous side view.
Fig. 39. Opposite side of same.
Fig. 40. Summit view.

Platycrinus semifusus, n. sp 77
Fig. 41. Lateral view.
Fig. 42. Basal view.

Platycrinus modestus, n. sp 77
Fig. 43. Lateral view.
Fig. 44. Basal view.
Fig. 45. Summit view.

Platycrinus germanus, n. sp 78
Fig. 46. Lateral view.
Fig. 47. Basal view.

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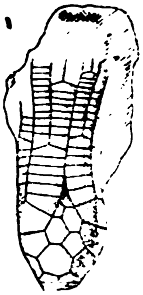
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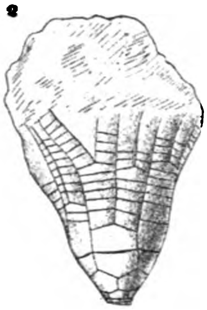
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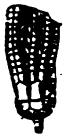
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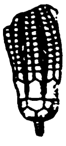
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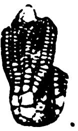
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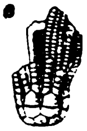
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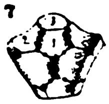
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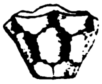
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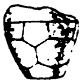
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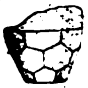
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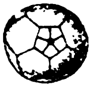
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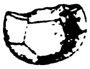
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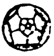
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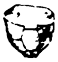
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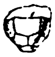
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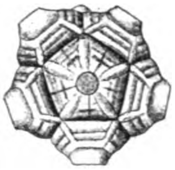
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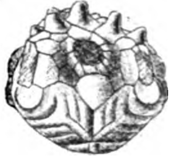
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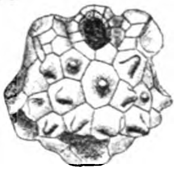
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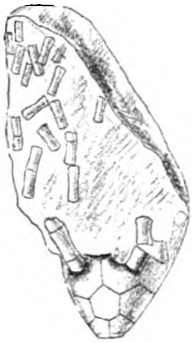
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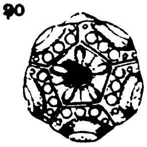
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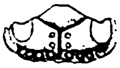
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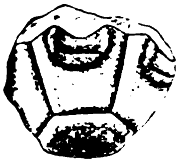
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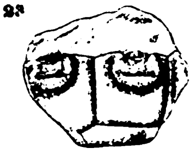
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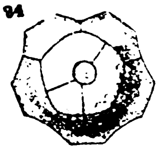
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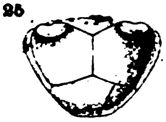
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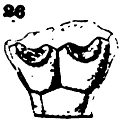
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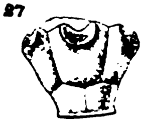
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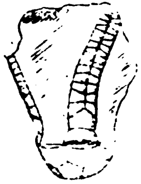
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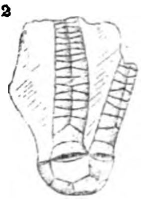
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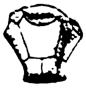
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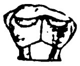
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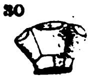
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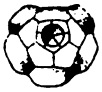
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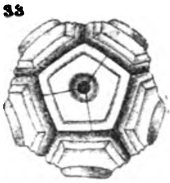
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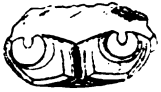
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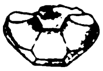
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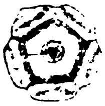
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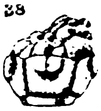
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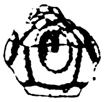
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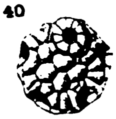
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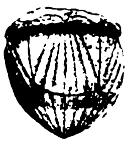
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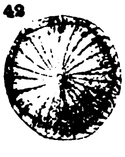
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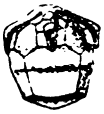
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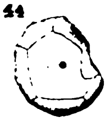
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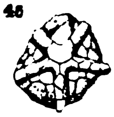
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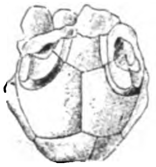
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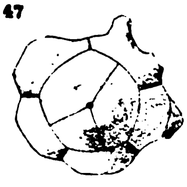


PLATE V.

Page.

Holocystites asper, n. sp. 84
- Fig. 1. Summit view.
- Fig. 2. Anterior view.

Holocystites sphaeroidalis, n. sp. 85
- Fig. 3. Summit view.
- Fig. 4. Left side view.

Cyrtoceras kansasense, n. sp. 88
- Fig. 5. Vental view.
- Fig. 6. Lateral view.
- Fig. 7. Showing septa and siphuncles.

Indianocrinus punctatus, n. sp. 83
- Fig. 8. Basal view.
- Fig. 9. Summit view.
- Fig. 10. Lateral view.
- Figs. 11, 12, 13. Same views magnified two diameters.

Spirorbis blairi, n. sp. 89
- Fig. 14. A specimen attached to a *Platystoma*.
- Fig. 15. An older example.

Hadrophyllum tennesseense, n. sp. 87
- Fig. 16. Summit view.
- Fig. 18. Summit view of another specimen.
- Fig. 17. Lateral view of the same.
- Fig. 19. Basal view of same.

Codaster blairi, n. sp. 86
- Fig. 20. Basal view.
- Fig. 21. Lateral view.
- Fig. 22. Summit view.

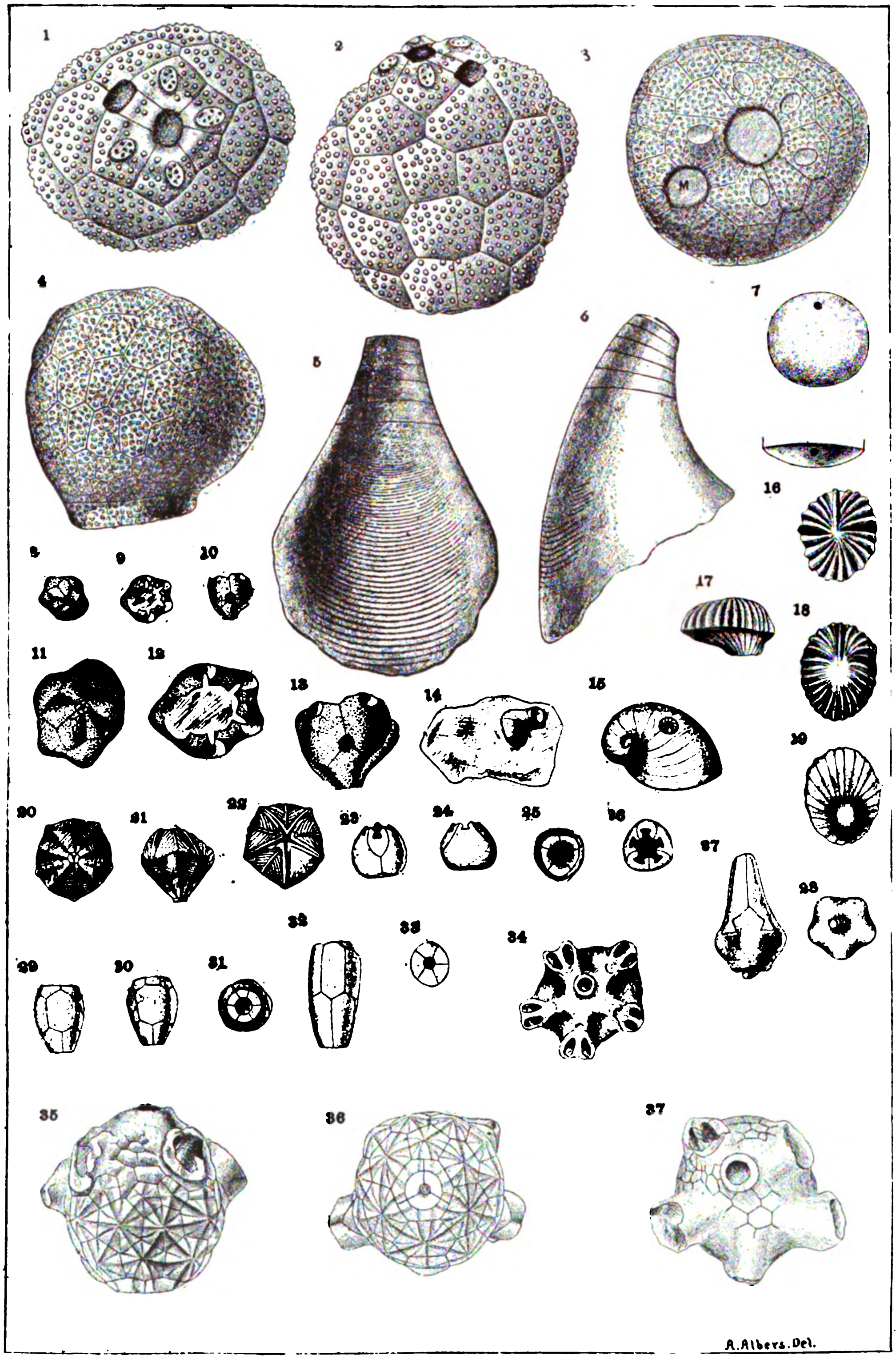
Pisocrinus baccula, n. sp. 79
- Fig. 23. Lateral view, showing small radial.
- Fig. 24. Lateral view showing large radial.
- Fig. 25 Basal view.
- Fig. 26. Summit view, all magnified two diameters.

Pisocrinus milligani, n. sp. 80
- Fig. 27. Lateral view, magnified two diameters.
- Fig. 28. Basal view of same.

Thalmocrinus ovatus, n. sp. 82
- Fig. 29. Lateral view, magnified two diameters.
- Fig. 30. Azygous side view of the same.
- Fig. 31. Summit view of same.

Thalmocrinus cylindricus, n. sp. 82
- Fig. 32. Lateral view, magnified two diameters.
- Fig. 33. Showing summit of second range of plates.

Amphoracrinus sedaliensis, n. sp. 54
- Fig. 34. Summit view of a small specimen.
- Fig. 35. Azygous side view of another specimen.
- Fig. 36. Basal view of the same.
- Fig. 37. Summit view of same.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